SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*REFORM IN MEDICAL EDUCATION.**

THE choice of a physiologist as the presiding officer of the Society of American Naturalists might, perhaps, have justified me in selecting some of the problems connected with experimental physiology as the subject of my remarks this evening, but, as questions of this sort are wont to awaken but a languid interest except among those who are themselves engaged in physiological research, I have thought it better to allow my choice of a subject to be guided by the fact that we are nearly all of us actively engaged in *teaching* as well as in *studying* our sciences, and to address you this evening upon some topic connected with education.

My own experience of 27 years as a professor of physiology and of 10 years as Dean of the Harvard Medical Faculty naturally inclines me to discourse upon the subject of medical education and, since the great profession of medicine demands from its practitioners a certain familiarity with the fundamental truths of all the natural sciences, it can surely not be inappropriate to ask the representatives of those sciences to consider with me how far the progress of medicine and of the allied sciences has made it desirable to revise our methods of imparting medical instruction.

*Address of the President, delivered before the American Society of Naturalists at the New York meeting, December, 1898.

Let me say at the outset that in speaking of the profession of medicine I use the term not in its narrow sense, to designate the art of curing disease, but in its broader signification, to include a study of the whole environment of man as far as it affects the production and maintenance of a healthy mind in a healthy body.

In what I shall have to say on this subject I shall confine myself chiefly to the medical schools of this country, though it will be found, I think, that the conclusions to which I shall endeavor to lead you will have their application to medical schools through the world.

The most important event in the history of medical education in this country occurred some thirty years ago, when many of the principal schools abandoned the plan of giving a series of winter lectures, which were attended by all the students, irrespective of their proficiency, and established a graded system of instruction in which the studies of one year were preparatory to those of the next. Those whose experience in medical education is confined to the period since this change was made can scarcely appreciate the value and importance of the reform which raised the medical schools of the country from a condition in which they were aptly compared to joint-stock manufacturing companies, concerned only in taking in as large an amount as possible of raw material in the shape of medical students and in turning out a maximum of the finished product, *i. e.*, doctors of medicine, with a minimum cost to the producer. 'Cheap doctors and plenty of them' seems to have been the motto of the medical schools of that period. Since this reform the medical schools of the country have been conducted on sound educational principles and the best of them compare favorably with the medical schools of Europe.

During the last quarter of a century the improvement in medical education in this country has consisted chiefly in increasing the requirements for admission, in the lengthening of the course and in the extension of the laboratory method of instruction. Important as these improvements have been, it may fairly be asked whether they have kept pace with the requirements imposed upon teachers by the remarkable advance in every department of medicine during the last thirty years.

During this period we have seen the germ theory of disease established upon a firm basis and extended so as to throw light upon a large number of morbid processes with which it was formerly supposed to have no connection. Antiseptic methods have revolutionized the surgeon's art. The study of the internal secretion of glands has led to the development of a system of glandular therapeutics. The use of the antitoxin treatment has robbed one, at least, of the most dreaded diseases of more than half of its terror, while the use of instruments of precision has increased the accuracy of our diagnosis in nearly all the ills to which flesh is heir.

At the beginning of this period it was possible to impart to an intelligent medical student in a three years' course of study a considerable fraction of the acquired medical knowledge of the time and to train him to safely use the comparatively simple methods of diagnosis and treatment then in vogue. At the present time, were we to seek to give to the same student a similar proportion of the accumulated knowledge now at the disposal of the profession and to teach him the use of the refined modern methods for the study and cure of disease, it may be reasonably estimated that a ten or even a fifteen years' course of study would be required. As it is obviously impossible to prolong the course of medical study to anything like this extent, the question arises: In what way shall newly ac-

quired knowledge in the science and practice of medicine be incorporated into the existing curriculum of the medical student?

Up to the present time this question does not seem to have been seriously considered. As new and important subjects have forced themselves upon the attention of the medical profession, our schools have sought to meet the new condition simply by adding to the existing curriculum a more or less lengthy course of instruction on the subject in question. Thus the importance of enabling physicians to recognize pathogenic microbes has led to the establishment of a department of bacteriology in our principal medical schools, while the great advance made in the treatment of special classes of disease has occasioned the appointment of numerous professors of specialties, such as gynæcology, orthœpedic surgery, pædiatrics, etc.

The medical curriculum has thus grown by what may be called, in biological language, a process of accretion, and there has been little or no attempt to make room for new instruction by the omission of less valuable courses or parts of courses, though in certain directions the advance of knowledge, by demonstrating the inaccuracy of previously accepted views, has led to a simplification of instruction. When it has been found absolutely impossible to add any further courses a remedy for the congestion of instruction has been found in the prolongation of the medical curriculum from three years to four.

It is, of course, evident that this process cannot be indefinitely continued. In fact, a slight study of the subject suffices to show that a limit has already been reached. Indeed, as long ago as 1870 Huxley was so thoroughly impressed with the crowded condition of the medical curriculum in England that he expressed "a very strong conviction that any one who adds to medical education one iota or one tittle beyond what is absolutely necessary is guilty of a very grave offence,"* and quite recently Professor M. Foster, in speaking of the enormously increased requirements in medical education, has expressed himself as follows: "Now it is obvious that, whatever may have been possible once, it is impossible nowadays to demand that all or each of these things should be learnt by the student of medicine. Though possibly the power of man to learn is increasing; though each science as it becomes more and more consolidated can be expounded and apprehended with greater ease; though the grasping of one science is in itself a help to the grasp of other sciences, yet beyond doubt that which has to be learnt is enlarging far more rapidly than is man's ability to learn."†

To extend the course of instruction in the medical schools of this country beyond the present four-year limit does not, under the prevailing conditions of education in America, seem desirable, and the curriculum of most of our schools is already so crowded that no considerable amount of instruction can possibly be added. In what way, then, can we give to our medical students an adequate amount of information on all the subjects embraced in the constantly widening domain of medical science and art? In other words, how shall instruction keep pace with knowledge?

In seeking an answer to this question it may be assumed that a medical school of the first rank should be an institution in which the most advanced instruction in all departments of medicine can be obtained, and on this assumption it is, of course, impossible to arrange a course of study that every student *must* follow in all its details, for in the time which may properly be de-

* 'Medical Education.' Collected Essays, Vol. III., D. Appleton & Co., 1894.

† Address to the Students of Mason University College, Birmingham, October 3, 1898.

voted to a course of professional study it is quite impossible for even the most intelligent students to assimilate all the varied information which such a school may reasonably be expected to impart.

It seems, therefore, to be evident that in arranging a course of medical study a distinction must be made between those subjects which it is *essential* that *every* student should know, and those subjects which it is *desirable* that *certain* students should know, *i. e.*, between those things of which no man who calls himself a physician can afford to be ignorant, and those which are important for certain physicians but not for all. In other words, provision must be made both for required and for *elective* studies.

The introduction of the elective system into a professional school is not an altogether novel proposition. For several years a large part of the instruction in the fourth year of the Harvard Medical School has been given in elective courses in various specialties, such as ophthalmology, otology, etc. The extension of the elective system to the earlier years of the course would be attended by no difficulty as far as details of administration are concerned, and has, indeed, been advocated by President Eliot in a speech at the dinner of the Harvard Medical Alumni Association in 1895. But the question may, perhaps, be asked whether it will be possible under such a system to secure the proper training of young men for the duties of a profession in which experience of life contributes so largely to success, and in which, therefore, a student at the beginning of his career may be supposed to be peculiarly in need of the guidance of his teachers.

It is true that in the academic department of Harvard University the capacity of the average student to choose his course wisely and well has been demonstrated by the experience of many years, but it may be properly urged that the success of the system in the academic department does not necessarily justify its extension to a professional school. The responsibility of the medical faculty in granting the degree of M.D. is very different from that of the academic faculty in giving the A.B. diploma, since an imperfectly qualified practitioner of medicine may endanger the lives of his patients, while an unworthy graduate of the academic department can, as a rule, injure no one but himself. Hence the medical faculty may justly be required to exercise greater caution in bestowing the degree of M.D. than is necessary in the case of the A.B diploma. We must, therefore, enquire whether it is possible to obtain the advantages of a flexible curriculum consisting largely of elective courses without losing the security against superficial and imperfect work which the present compulsory system is supposed to afford.

Any one who is familiar with the existing methods of medical instruction is aware that in nearly every department many things are taught which are subsequently found to be of use to only a fraction of those receiving the instruction. Thus the surgical anatomy of hernia is taught to men who will subsequently devote themselves to dermatology; future obstetricians are required to master the details of physiological optics, and the microscopical anatomy of tumors forms a part of the instruction of men destined to a career as alienists. Now, no one can question the propriety of including instruction on all these subjects in the curriculum of a medical school, but it may be questioned whether *every* student should be forced to take instruction in them *all*. It may, perhaps, be urged that no choice of studies can be made without determining, to some extent, the direction in which the work of the future practitioner is to be specialized, and that such specialization cannot be properly and safely permitted until the student has completed his medical

studies. To this it may be answered that, whatever may be the dangers of too early specialization, the dangers of crowding the medical course with instruction of which many students do not feel the need and of thus encouraging perfunctory and superficial work are certainly no less serious. Moreover, it will, doubtless, be found perfectly possible to establish such a relation between the required and the elective courses that the requirements in each department will be in no way lowered, while a certain freedom of choice is permitted with regard to the direction in which the work is pursued. To illustrate this point, allow me to describe a possible arrangement of a course of study in the department of physiology with which I am, of course, more familiar than with any other.

In the Harvard Medical School instruction in physiology is now given in a course of about 100 lectures, besides recitations, conferences and practical laboratory work. Were the work to be rearranged in accordance with the above plan it would probably be found possible to condense into a course of about 50 or 60 lectures all the most important facts of physiology with which every educated physician must necessarily be familiar. Attendance upon these lectures, combined with a suitable course of text-book instruction, would suffice to guard against gross ignorance of physiological principles. In addition to this required work, short courses of eight or ten lectures should be provided, giving advanced instruction in such subjects as the physiology of the special senses, cerebral localization, nerve-muscle physiology, the internal secretion of glands, the physiology of the heart, circulation and respiration, the digestive secretions, the reproductive organs, etc. These courses should be elective in the sense that no student should be required to take them all. Each student might, however, very properly be required to choose a certain number of courses, which, when once chosen, become, for him required courses leading to examinations. The number of special courses which each student should be thus required to elect should be sufficiently great to render the total amount of physiological instruction in no way inferior to that which is given under the present system.

It would, doubtless, be found desirable in practice not to confine the possibility of taking elective courses to the year in which the required instruction is given, for a student may frequently, in the latter part of his course, become interested in a subject like mental diseases, for instance, and will then be glad of an opportunity to take special instruction on the physiology of cerebral localization. The elective courses should, therefore, be so arranged that they may be taken in any part of the medical curriculum.

There is, in my opinion, no doubt that an arrangement of instruction similar to that here suggested for physiology could be advantageously adopted in the departments of anatomy, histology, bacteriology, medical chemistry, pathology, surgery, and in the courses of instruction in the various special diseases, such as dermatology, opthalmology, etc. Whether the instruction in clinical medicine and clinical surgery can be thus modified is a question about which more doubt may be entertained and which I prefer to leave to persons of greater experience than myself in methods of clinical instruction.

Under the existing conditions of medical education the introduction of the elective system in some form or other seems to be an essential condition to any further important advance. If it be said that under this system the medical degree will cease to have the definite meaning now attached to it, and that it will be impossible to tell from his

diploma in what way a physician has been educated, it may be replied that, though the degrees of A.B., A.M., Ph.D. and S.D. are affected with exactly this same uncertainty of signification, their value seems in no way diminished thereby. As long as the M.D. degree stands for a definite amount of serious work on medical subjects directed on the lines above indicated we may be reasonably sure that those who hold it will be safe custodians of the health of the community in which they practice.

If it be urged that the elective system in medical education will lead to the production of a class of physicians who, owing to the early specialization of their work, will be inclined to overrate the importance of their specialty and to see in every disease an opportunity for the display of their special skill, it may be pointed out that this result is apt to be due not so much to early as to imperfect instruction in the work of a specialist, and that, since the elective system tends to encourage thoroughness in special instruction, the evil may be expected to diminish rather than to increase.

I have spoken of the extension of laboratory instruction as an important forward step in the improvement of educational methods in medicine during the last quarter of a century, and I desire to bring my remarks to a close with a few words on the relation between laboratory and didactic methods in medicine and on the employment of both methods in a system of instruction including both required and elective courses.

There is perhaps no field of human activity in which the pendulum of reform makes wider excursions than in that of education. Whenever any given method is found to give unsatisfactory results there is a strong tendency to abandon it altogether in favor of some entirely different method. Thus the obvious defects of the oral system of examination employed in the Harvard Medical School thirty years ago led to its complete abandonment and to the adoption of the written examination book, though there is little doubt that a system combining the advantages of both the oral and the written methods could easily have been devised. In the same way the fact that many subjects have been, and indeed still are, taught in systematic didactic lectures which can be better taught by laboratory methods tends to obscure the equally important fact that there are many other subjects in the presentation of which the living personality of the lecturer is a very important factor and which, indeed, can be properly presented to students only by those who have had much experience in weighing scientific evidence. In this connection it is interesting to recall the wise words of Huxley, who expressed himself on this subject as follows: "What the student wants in a professor is a man who shall stand between him and the infinite diversity and variety of human knowledge, and who shall gather all that together and extract from it that which is capable of being assimilated by the mind."*

To what extent the laboratory can replace the lecture room will, of course, depend upon the nature of the subject taught. In such a branch as Anatomy, where facts learned by observation form the greater part of the knowledge to be imparted, laboratory work can be substituted for didactic instruction to a greater extent than is possible in subjects like Physiology and Pathology, where inferences from observations and conflicting views must frequently be presented. In no department of medicine, however, will it probably be found possible to dispense entirely with a systematic course of lectures in which a trained instructor may give to his class the benefit of his accumulated experience.

* l. c.

A consideration of the nature of the subject taught will also furnish a guide for the employment of laboratory and didactic methods in the required and elective courses above suggested. In general the required courses, being comparatively elementary and concerned chiefly with the presentation of well ascertained facts, may be made demonstrative in their character and may be conducted in accordance with laboratory methods, though a short course of didactic lectures, parallel with laboratory work, will in most cases be found to be essential. In the elective courses which provide advanced instruction in many directions the limits of our knowledge will be more nearly reached. It will, therefore, be necessary to present and weigh the evidence for and against the various conflicting views which are almost certain to be held with regard to subjects lying within what Foster has called the 'penumbra' of solid scientific acquisition. For this purpose the most suitable method of instruction seems to be a short course of carefully prepared didactic lectures which should, however, be varied by demonstrations whenever the nature of the subject will allow.

It is, however, unnecessary to discuss these and other details at the present time. They will speedily arrange themselves as soon as the necessity for a comprehensive reform in our methods of medical instruction is generally recognized, and it is in the hope of helping to secure this recognition that I have addressed these remarks to you this evening. In whatever way the remedy is to come it should not be long delayed, for the difficulty of giving adequate instruction to constantly increasing classes seeking information over a constantly widening field of knowledge is felt each year with greater and greater keenness.

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*ON THE INCREASING IMPORTANCE OF INORGANIC CHEMISTRY.**

WHENEVER a paper by Van't Hoff appears, it is read by chemists and especially by physical chemists, with unusual interest. This is due to the fact that the comparatively few papers which he has published have had such a marked influence on scientific thought, and on the development of those branches of knowledge to which he has devoted his energies.

The present lecture is probably the result of his observation, since he has been in Berlin, that by far the larger number of German chemists are devoting themselves to organic chemistry. At the same time that he recognizes the importance of this field of investigation, he utilizes this opportunity to call attention to the difference between the two branches of chemistry, organic and inorganic, and to point out some of the advances which have been made, especially in the latter. The main points of his lecture will be given partly in his own language, and partly as a free account of what was said.

The distinction between organic and inorganic compounds dates back some two hundred years. Those occurring in organic nature, in living things, were called organic, while those existing in the mineral kingdom were called inorganic. This division had, at the outset, a certain scientific justification, since inorganic chemistry had to deal with the comparatively simple problem of explaining the chemical transformations in dead matter, while organic chemistry dealt with the much more complex problem of the processes in living organisms.

While the original definitions of the two branches have changed somewhat as new facts have been discovered, yet this essential

* Lecture before the 70th meeting of the Society of German Scientists and Physicians in Düsseldorf. —*Ztschr. f. Anorganische Chemie*, 18, 1.

difference still exists, that inorganic chemistry has to do with the relatively simpler, organic with the more complex problems. If we arrange the exact sciences in the order of increasing complication of the problems dealt with, we shall have inorganic chemistry more closely allied to physics, and organic chemistry to biology. The order would then be: Physics, inorganic chemistry, organic chemistry, biology.

Organic chemistry has now come to be the chemistry of the element carbon, while inorganic chemistry is that of the remaining 70 elements and their compounds. But we know that this distinction is not a sharp one, since sodium and calcium carbonates are treated in all works on inorganic chemistry. The two chief divisions of chemistry are, then, at present, best characterized by aim and method.

The more difficult problem in inorganic chemistry is the decomposition of substances into simpler compounds, and finally into the elements, so that the greatest triumph in inorganic chemistry is the discovery of new elements (Argon and Helium by Ramsay and Rayleigh). It finds the most complete expression of its results in the natural systems of Newlands, Mendeléeff and Lothar Meyer. The inorganic compounds are relatively simple, generally easy to obtain, and have a definite qualitative and quantitative composition.

The reverse is true in organic chemistry. Decomposition is easily effected, as by oxidation. The aim here is to synthesize compounds, and this is rendered difficult by the possibility of isomerism; substances being formed of the same composition, but of different constitution and properties. Organic chemistry triumphs in the artificial building-up of substances (the preparation of the different sugars by Fischer), and finds the most complete expression of its results in the structure theory and in stereochemistry.

The entirely different aims of the two branches of chemistry necessitate a corresponding difference of methods. As is well known, inorganic and organic chemistry are now studied independently. At the beginning of this century a great impulse was given to the study of chemistry by the discovery of the fundamental principle: "*The Mass of Matter does not change even in the most deep-seated transformations.*" At first the harvest was reaped chiefly in inorganic chemistry. The very important facts, discovered purely empirically—the impossibility of transforming one element into another, the weight and volume relations in chemical transformations—receive their hypothetical expression in the atomic and molecular conceptions and the molecular formula is the picture of the knowledge thus obtained.

Then came the harvest in organic chemistry. The methods of quantitative analysis were gradually adapted to the more complex relations in this field, and the constitution or configuration formula appeared, as a simple, clear picture of the relations. It indicated not only the kind and number of atoms in the molecule, but also their inner connections and their relative position.

Yet, organic chemistry has done comparatively little towards explaining the phenomena of life. The results of organic chemistry, expressed in the constitution formulas, are of relatively little significance for assimilation, etc. Also the knowledge of the constitution of albumin would thus be scarcely extended. "It appears to me as if this incapacity is conditioned also by the nature of the configuration formula. It represents the molecule as a solid unit, and corresponds, therefore, at best, to the relations which obtain at absolute zero, *i. e.*, at $-273°$, and long before this all life processes are extinguished. The inner molecular state is explained for conditions under which life ceases."

Let us now look more closely at the condition of things at the present time. The discovery of thiophene by Victor Meyer, and Fischer's work on the sugars, are referred to. Notwithstanding the relatively small number of workers in inorganic chemistry in recent years, very brilliant results have been obtained. Those mentioned are: The discovery of the volatile compounds of iron and nickel with carbon monoxide, by Mond; of triazoic acid by Curtius; of six new elements by Ramsay; the artificial preparation of the diamond by Moissan; the carbides, selenides and borides, prepared by the same investigator.

Let stress be laid upon it that this experimental result is, in part, dependent upon the use of electricity, which is applicable chiefly to inorganic compounds. Let us examine more closely the details of this application; what electricity has already done, on the one hand as a source of higher temperatures, on the other as a means of effecting separations.

Electricity as a source of heat is of fundamental importance. The temperatures which can be reached by combustion processes are limited. By this means we cannot obtain temperatures very much above 3,000°. In the electric furnace temperatures as high as about 4,000° can be reached.

The electric furnace, in the hands of Moissan, has opened up a new way of preparing valuable and important substances. It is evident that this applies chiefly to inorganic chemistry. Higher temperatures do not form, but break down the molecular complexes which constitute the problems of organic chemistry. Our own existence, which depends chiefly on the interaction of such complex molecules, cannot be continued up to 50°. The compounds of the hydrocarbons which were obtained in the electric furnace, as carborundum and calcium carbide, have no value for the synthetical processes of organic chemistry.

If we turn to electricity as a means of separation, it is self-evident that it can be only indirectly applied to organic chemistry, whose chief aim is synthesis. Most of the organic compounds do not belong to the electrolytes, which can be broken down by electrolysis. Most of the metals can, however, be separated by the current, in a form suitable for weighing, by using the proper intensity of current, and can be separated from one another by using a suitable electromotive force. The halogens have recently been separated in the same manner. A step is thus taken for inorganic analysis, which is comparable to the work of Liebig on the analysis of organic substances.

What has been accomplished by the use of electricity in separating the metals on a large scale, can be seen from the following data: In 1897 one-third of the entire copper produced (137,000,000 kilograms) was obtained electrolytically. The larger part of the gold and silver were obtained in the same way. Sodium is produced entirely by electrolysis (260,000 kilograms in 1897), and the increase in the aluminium produced, from 9,500 kilograms in 1888 to 321,000 kilograms in 1894, is to be referred to the same cause. This aluminium can now be used for the preparation of other metals which were difficult to obtain. At the last meeting of the Electro chemical Society in Leipsic we saw almost chemically pure chromium prepared by suitably igniting a mixture of aluminium and chromium oxide. In the same manner, manganese, titanium, tungsten, vanadium, cerium, etc., were formed. This opens up a field in the metal alloys, which will, perhaps, be of technical importance.

We thus see inorganic chemistry teeming with remarkable discoveries, enriched by a new method of preparing substances, and

simplified analytically. The ground is also unusually fruitful for applying and developing the fundamental generalizations which have been reached in chemistry in the last few years.

When, in 1843, Kopp declared that a new stage of development in chemistry would follow the period of quantitative investigation, first by union with another branch of science, he saw in advance what is now being effected in the union of chemistry and physics, which is being accomplished by the new physical chemistry. Let us call attention to the importance of applying the two fundamental principles of thermodynamics to chemistry, and how far consequences derived from these principles can be subjected to experiment, and what the result is.

The problems solved in this way, belong to the most important of our science, but receive a solution which has so little in common with our atomic and structural conceptions that they often do not appeal to chemists trained in the latter school. By this means problems will be solved, also biological problems, which lie out of the scope of the configuration method. By applying thermodynamics to chemistry it is chiefly inorganic chemistry which is advanced.

We must mention first the problem of affinity. Thermodynamics does not refer affinity to the reciprocal action of atoms, but measures affinity by the maximum work which the reaction can perform. Let us consider reactions which take place with increase in volume, say the union of copper and calcium acetates to form the double salt. If this reaction takes place in a closed vessel, the walls are broken. On the other hand, the reaction can be hindered by bringing a counter pressure to bear on the salts, say by a piston and cylinder; and Spring has actually shown that the double salt can be broken down by subjecting it to several thousand atmospheres of pressure. This counter pressure, which just prevents the reaction, is very closely connected with affinity regarded as force, and affinity is determined as work by the mechanical work which is done by the reaction against the maximum pressure.

The reaction may complete its maximum work in other ways, as in an electric battery, and it can then be measured from the electromotive force of the battery.

We arrive, in this way, at a generalization of very great importance:

A transformation will, then, only take place of itself in case it is in a position to do a positive amount of work. If the amount of work done is negative the transformation can only take place of itself in the opposite sense. If the work done is zero it can take place in neither sense.

This work and the possibility of reaction depending upon it, can be calculated in any given case, provided the work is ascertained, once for all, which is done when each of the substances in question is formed from the elements. This work can be expressed, *e. g.*, in calories. This 'work of formation,' by simple addition and subtraction, leads to the 'work of transformation,' the sign of which conditions the possibility of the transformation. This program has been carried out, to a certain extent for the mercury compounds, by Nernst and Bugasky. It should be mentioned that from this principle it was foreseen that mercurous chloride must be decomposed by potassium hydroxide, although the transformation takes place with heat absorption.

We have obtained, also, a generalization for reactions which only partly complete themselves, on account of the introduction of the opposite reaction, which leads to a condition of so-called chemical equilibrium, as in the combination of iodine and hydrogen, and in etherification. It is essential that, in such cases, changes in concentration should be produced during the reaction, and on account of the reaction. These decrease the work of transformation, finally

bringing it to zero, whence the reaction velocity gradually decreases and finally, also, becomes zero. In the union of iodine and hydrogen the increasing concentration of the hydriodic acid formed, introduces a gradually increasing opposing force, which finally brings the reaction to rest.

There is thus obtained a further principle, applicable in many directions. The point at which a reaction comes to rest can be calculated from the work of transformation. This was strikingly confirmed very recently by Bredig and Knüpffer, on the basis of measurements of electromotive force; it was accurately determined when the double decomposition of thallic chloride and potassium sulphocyanate came to rest.

But also the change in work of transformation through changes in temperature, pressure and mass can be calculated from thermodynamics, and also the consequent shifting of the point of equilibrium. Quantitatively expressed, this shifting always takes place in the sense that cooling favors whatever is formed with evolution of heat, until finally, at absolute zero, all reactions are completely displaced in this sense. Then the course of the reaction would be conditioned by the 'heat of transformation,' which, at zero, would be equal to the work of transformation.

In studying equilibria from this standpoint, not only the *existence* of every substance, but also the *conditions of existence*, are determined. And it may be added, not only the conditions of existence of individual substances are determined, but also all the compounds which it is possible to obtain from given materials, say water and salt. The reinvestigation of magnesium chloride from this standpoint gave not less than six different hydrates.

This method of investigation closely resembles the complete survey of a region where formerly only individual cities and villages were recorded. In the not very distant future inorganic chemistry may do for geology what it has already done for mineralogy in the preparation of individual minerals.

The views here expressed will be of chief service in inorganic fields, since two obstacles are in the way of applying them to organic chemistry: First, the great possibility of compound formation. A single pair of substances, as carbon and hydrogen, gives rise to an unlimited series of compounds. Second, the very sluggish manner in which organic transformations take place, causes reactions which are possible, to proceed very slowly, or not to take place at all. Thermodynamics stands here, in its application, as before a very complex engine which is rusted until it is useless.

But the application of thermodynamics to chemistry has been made in another direction, and here the physical chemistry of to-day has found its most fruitful field. The possibility of determining the molecular weight of dissolved substances is given by the so-called osmotic methods. A very great need of inorganic chemistry would thus be met. The molecular weights of organic compounds, which are often volatile, were generally known by determinations of vapor-density. The inorganic compounds investigated in this respect were, on the other hand, exceptions. The work of a few years has sufficed to fill up these omissions.

We arrive, then, at our last point, a consequence of these osmotic methods, that electrolytes—salts, acids and bases—are broken down in aqueous solution in a peculiar manner. The only explanation which meets the case is that of Arrhenius, according to which a dilute solution of, say hydrochloric acid, would contain instead of molecules of acid, negatively and positively charged atoms of chlorine and hydrogen.

It is still impossible to pass final judg-

ment on this fundamental change of our conceptions, yet it is a fact that the most widely different properties of solutions agree qualitatively with the new conceptions. Quantitatively, the result calculated agrees very nearly with that found, but, thus far, the agreement is not always perfectly satisfactory. It is of chief importance for our purpose that a new impulse was thus given to the study of solutions of salts, acids and bases, *i. e.*, chiefly to inorganic compounds.

A final remark in closing: While it has been repeatedly emphasized, in the foregoing that it is chiefly inorganic chemistry that has been advanced by the new theoretical considerations, yet it is not meant that organic chemistry has thus lost in interest. On the contrary, the science of chemical equilibrium can be applied also here, and has already been thus applied.

The action of ferments is then taken up, and the work of Tammann and others cited to show that such act, at least in some cases, to only a limited extent, a condition of equilibrium being reached before the decomposition is complete. Thus, amygdalin is only partly broken down by emulsin, and the breaking-down goes farther if the decomposition products are removed. If, on the contrary, he had added the decomposition-products he would, perhaps, have effected the synthesis of amygdalin. In case the ferment is not changed by its action, on theoretical grounds a condition of equilibrium must be introduced, and not a total transformation, and, therefore, the opposite reaction should be realized. It is a fair question to ask whether (from the science of equilibrium) sugar cannot be formed from carbon dioxide and alcohol, under the influence of zymase, when the pressure of the carbon dioxide exceeds a certain limit; and also whether trypsin is not in the position, under conditions given by the science of equilibrium, to form albumin from the decomposition products which it itself yields?

"If I have gone too far in these last expressions they may remain as proof that I always have a warm heart for organic chemistry." Van't Hoff concluded with the wish that Germany, which is in danger of being surpassed in inorganic chemistry by other nations; which has recently lost from this field such men as Victor Meyer, Lothar Meyer, Gerhard Krüss and Clemens Zimmermann, will soon again occupy a leading position, through the choice of young men of our science to enter this field.

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JOHNS HOPKINS UNIVERSITY,
November, 1898.

THE TAILLESS BATRACHIANS OF EUROPE.*

THE anurous salient amphibians, or tailless batrachians, have been long favorite subjects of study in Europe, and much has been written upon their habits. Only a few years ago (in 1890) Dr. J. de Bedriaga published an elaborate monograph of the Amphibians of Europe (Die Lurchfauna Europas) giving very full descriptions of the species and their manner and customs. Now we have completed a still more elaborate work on a single order of Amphibians —the Salientia—including the frogs and toads and their relations. This work, entitled 'The Tailless Batrachians of Europe,' is by Mr. G. A. Boulenger, and has been 'issued to the subscribers to the Ray Society,' in two bound volumes or parts for the years 1896 and 1897; the pagination is continuous from the first into the second volume (pp. 211–376). Doubtless many of the 'subscribers' will rejoice in the diversification of the subjects monographed, for nearly a

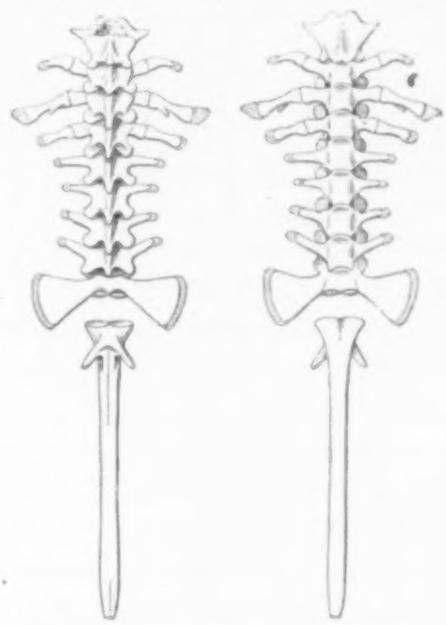
*The Tailless Batrachians of Europe. By G. A. Boulenger, F.R.S. London: printed for the Ray Society. 1897–1898. 2 parts, 8vo., t. p., iii, 376 pp., 24 pl., 7 maps.

generation has passed since any volume on vertebrates was published, the last having been 'a monograph on the structure and development of the shoulder girdle,' by W. K. Parker, issued for 1867. All the volumes published since 1880 have been devoted to insects in the Linnæan sense.

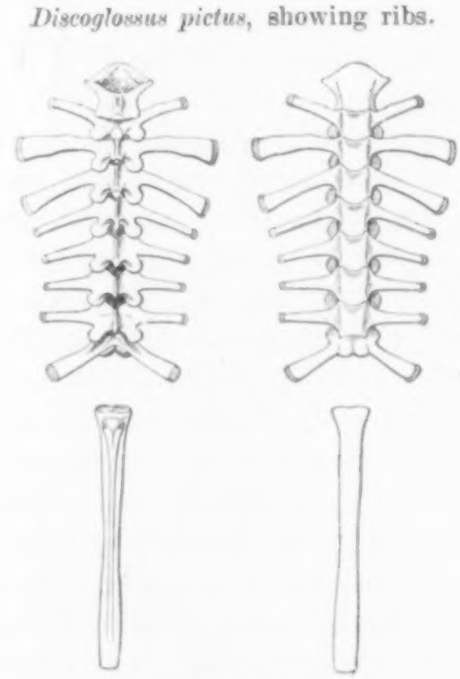
Mr. Boulenger has been 'for twenty-five years a close student and collector of these animals, which have always exercised an extraordinary fascination' on his mind and he has utilized 'the enormous material which had gradually accumulated in the literature, [his] own notes, and the unrivalled collection in the British Museum.' The outcome is worthy of the distinguished author, and we have a monograph which may serve as a model for other lands, and not least for the United States.

The first third of the work (p. 1–121) is an 'introduction' to Amphibiology, treating of the classification, external characters, integument, dermal secretion, skeleton, viscera, habits, voice, pairing and oviposition, spermatozoa, eggs, development and metamorphosis, tadpoles, hybrids, and geographical distribution. This introduction is illustrated by forty-seven cuts and three plates representing anatomical and physiological data. A most useful feature is the exhibition in dichotomous form of the 'external characters' (17), the 'osteological characters' (44), 'the chief differences in male uro-genital apparatus' (55), the amplexation or mode of embrace of the male (69), the nuptial asperities (70), 'the principal differences between the eggs' (79), and the characteristics of the tadpoles (105).

The characters thus clearly analyzed and exhibited among the Anurans may be considered to have been coordinated, and the resultant is a classification which expresses quite nearly an equation for the collective characters and is, therefore, a 'natural classification.' So uniform are the external characters that not only are they no criteria of the mutual affinities of the various forms, but they are actually often misleading. The early naturalists distinguished among the phaneroglossate forms those with the upper jaw toothed or toothless and those with toes having terminal disks contrasted with



Discoglossus pictus, showing ribs.



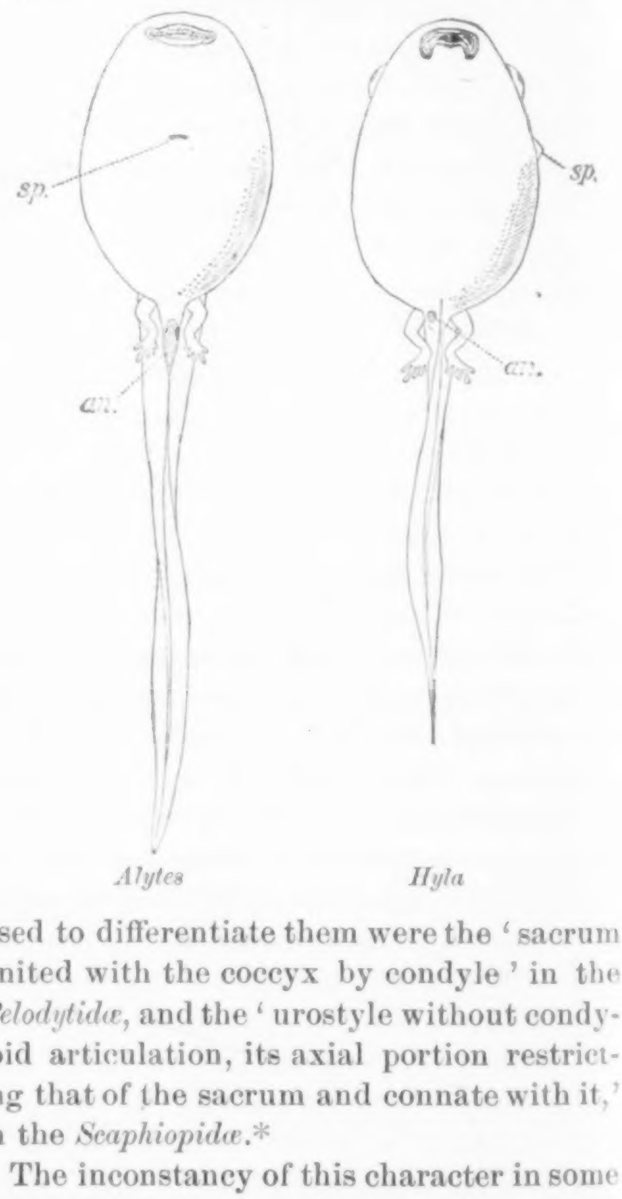
Rana esculenta.

those without disks. Other characters were found in the presence or absence of a 'tympanum' or 'ear' and of 'parotoid glands' as well as other less-used variations. It became evident, however, that none of the

arrangements based on such characters was an expression of deep-seated affinities. It was not till 1865 that a key to the definitive arrangement of the group was discovered by Cope in the osteological characters and especially modifications of the sternal apparatus. Cope's arrangement has been called by Mr. Boulenger an 'epoch-making classification' and, in the form to which it has been brought by the later labors of Cope and Boulenger, will doubtless be near that which will gain ultimate general acceptance. Nevertheless, it may be thought too much value has been attached to the arciferons type of sternum. An arrangement of the phaneroglossate forms into three superfamilies, of which the arciferous family of *Discoglossidæ* is the most generalized, may be more acceptable to some; this has been named DISCOGLOSSOIDEA. The other Arcifera are the BUFONOIDEA, and the FIRMISTERNIA are equivalent to another superfamily of nearly equal systematic importance—the RANOIDEA.

The Discoglossoidea differ from both the others in the possession of ribs in the adult, and by the median position of the spiraculum or outlet from the branchial chamber in the tadpole. Less important peculiarities are the arrangement of the male urogenital apparatus (so that 'the spermatozoa are conveyed through the vasa efferentia direct to the seminal duct; the latter produced forward beyond the kidney') and the disposition of the labial teeth series 'in two or three rows.' The single family—*Discoglossidæ*—contains three European genera and five species; the genera were widely separated by the old systematists, and it was to Cope that the earliest appreciation of their relationship was due.

The Bufonoidea, or typical Arcifera, are represented in Europe by three families—*Pelobatidæ*, *Bufonidæ* and *Hylidæ*. The *Pelobatidæ* of Boulenger were distributed by Cope among two families, one of the European genera (*Pelodytes*) having been designated as the type of Pelodytidæ, and the other (*Pelobates*) associated with the American *Scaphiopus* in the family Scaphiopidæ. There can scarcely be any question that Boulenger is correct in reducing the two Copian families to one. The only characters



Alytes *Hyla*

used to differentiate them were the 'sacrum united with the coccyx by condyle' in the *Pelodytidæ*, and the 'urostyle without condyloid articulation, its axial portion restricting that of the sacrum and connate with it,' in the *Scaphiopidæ*.*

The inconstancy of this character in some groups has been shown by Boulenger. "Dugès, basing his observations [on the *Pelobates cultripes*], has denied the fusion of the sacral vertebra with the coccyx described by Mertens in *Pelobates fuscus*, with which *P. cultripes* was then confounded; he observes, however, that the articulation, by means of one condyle, is an almost immovable one.

*Cope Batr. N. Am., 296.

In a specimen from Bordeaux, from which [Boulenger] prepared the first skeleton, [he] found matters as stated by Dugès, whilst in two other skeletons, from Bordeaux and Avignon, the two bones are as completely fused as in *P. fuscus*." Mr. Boulenger well adds: "As the ankylosis of the sacrum and coccyx has been given as a generic character of *Pelobates*, it is important to note the inconstancy of the character in this species at least." Still less is the character of family value. Further, an examination of the skeletons of *Pelodytes*, *Pelobates* and *Scaphiopus* should convince a competent observer that the difference between *Pelobates* and *Pelodytes* are much less than those between *Pelobates* and *Scaphiopus*. *Scaphiopus* differs from *Pelobates* in the reduced dilatation of the diapophyses of the sacral vertebra, the strength and direction of other diapophyses, the cartilaginous 'xiphisternum,' the absence of a bony style, and the development of a 'cavum tympani and tympanum.' In all the contrasted characters *Pelobates* agrees with *Pelodytes*, and, if the family is to be divided, the two European genera should be combined and contrasted with the American. The eminent herpetologist who associated *Pelobates* with *Scaphiopus* was too much impressed at first with the special osteological character used, and neglected to make a detailed comparison which would have convinced him of its inferior value.

The Ranoidea are represented in Europe by only a single genus—*Rana*—although 8 of the 20 anurans belong to it.

Mr. Boulenger has paid much attention to the geographical distribution of the European species and has devoted a number of maps (6) to the exhibition of the range of the representatives of a family, genus, or of nearly related species or varieties. We may extend the view by a comparison of the European fauna based on Boulenger's figures with the North American, accepting, therefore, the numbers given by Cope in 'The Batrachia of North America.'

	Europe.	N. Amer.
DISCOGLOSSIDÆ		
Discoglossus	1	
Bombinator	2	
Alytes	2	
PELOBATIDÆ		
Pelodytes	1	
Pelobates	2	
Scaphiopus		2
Spea		2
UPEROLIIDÆ (CYSTIGNATHIDÆ or LEPTODACTYLIDÆ)		
Lithodytes		2
Syrrhopus		4
BUFONIDÆ		
Bufo	3	10
HYLIDÆ		
Hyla	1	9
Pseudacris (Chorophilus)		6
Acris		1
Smilisca		1
ENGYSTOMIDÆ		
Engystoma		1
Hypopachus		1
RANIDÆ		
Rana	8	13

It will be seen from these columns that the North American fauna is much richer than the European. The chief differences, otherwise, are the absence of Discoglossids in America and the great development in North America of the Hylids—17 American against a single European species. There is no great disparity between the other families, although for each the American species are more numerous than the European. The families indicated as represented in North America and not in Europe do not really belong to the Anglogæan fauna, the species in question barely extending within the limits of the United States, the only notable exception being the *Engystoma carolinense*, which extends as far north as South Carolina and Missouri.

The chief interest to most lovers of nature will be in the accounts of the habits of

the species, and these, as a whole, are detailed more fully and with more discrimination than in any other work. Especially noteworthy are the descriptions of the courtship and oviposition of the species. The 'amplexation,' or mode of approach of the males on the females, is characteristic, and in main features is common to the members of a genus, so far at least as the European species are concerned. So generally in conformity with structural features has it been regarded that the principal modifications have been used to differentiate and diagnose certain groups. Attention was first called to the subject by A. Thomas in 1854, and two groups were named by Bruch, in 1863, *Plagioglena* and *Orthoglena*, and by A. de L'Isle, in 1877, *Alamplexes* and *Inguinamplexes*. But the want of correlation between such characters and structural ones is now evident. Mr. Boulenger (p. 2) well remarks: "How exaggerated the importance attached to this correlation, which, besides, holds good only for the European forms, is now apparent to all." Nevertheless, within

Amplexation of '*Pelodytes punctatus*'

certain limits, the species of a genus agree in their mode of amplexation; only a too strict taxonomy cannot be applied. For example, Mr. Héron-Royer (Bull. Soc. Zool. France, 1890, 205) recognized 7 categories of amplexation—pectoral, axillary, supra-axillary, inguinal, axillo-in-

Amplexation of '*Bufo vulgaris*'

guinal, lumbo-pubic, and lumbar. Now, Mr. Héron-Royer recognized five European species of *Hyla*, which are considered by Mr. Boulenger to be varieties or variations of the single species *Hyla arborea*, and yet two of the nominal species are referred to one category (axillary) and three to another (supra-axillary). One of the European toads (*Bufo viridis*) has a pectoral amplexation, two (*B. vulgaris* and *B. calamita*) an axillary, and the common American species (*B. musicus* or *lentiginosus*), a supra-axillary habit. In fact, such differences may be simple expressions of the relative size of the male and female and must vary as do the sexes. But there is a sharp contrast between amplexation round the waist and

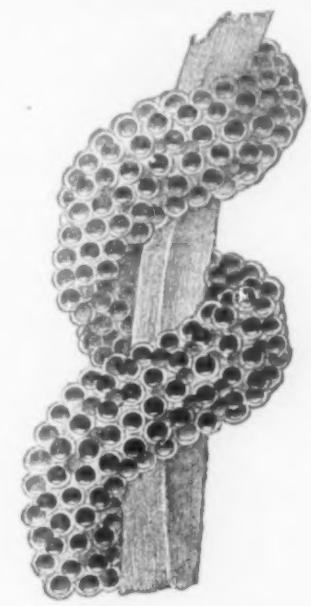
that behind or above the arms, and these two categories are the chief ones recognized by Mr. Boulenger. The former mode is exemplified by all the species of Discoglossids and Pelobatids; the latter by the Bufonids, Hylids and Ranids. Four kinds or degrees of amplexation are represented by admirable illustrations in Mr. Boulenger's work and are here reproduced. Among the Pelobatids the hands join on the pubic

Amplexation of '*Rana arvalis*.'

region in *Pelobates*, while the forearms meet on the pubic region in *Pelodytes*. It will be in order now for some observer to tell us how *Scaphiopus* practices amplexation; the various accounts hitherto published fail to give the requisite information.

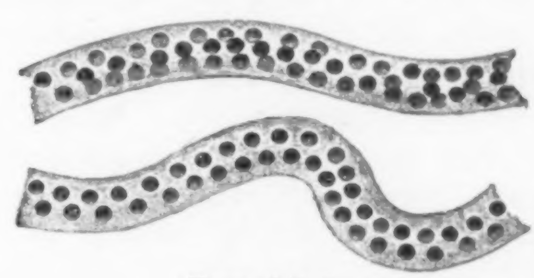
Every sojourner in the country must have noticed masses of transparent jelly-like spheres in the water, but none in the United States could refer such masses with certainty to the parent species. In Europe, however, such an identification can be made in almost every case, and Mr. Boulenger gives a synopsis for that purpose, and adds illustrations of the oviposition of seven species representing all of the five European families. Some of these illustrations are here copied.

The tadpoles of the European anurans have also been described and figured, and each species may be readily identified by means of an excellent analytical key (105–109). The tadpoles of *Rana*, for example,



Eggs of *Pelodytes*.

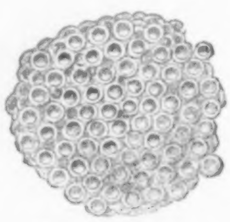
are differentiated *inter se* by the relative width of the interocular space, the series of labial teeth, and the form of the tail. Mr. Boulenger deduces the generalization that "the structural differences which separate the genera and species in their tadpole condition reflect, on the whole, pretty accu-



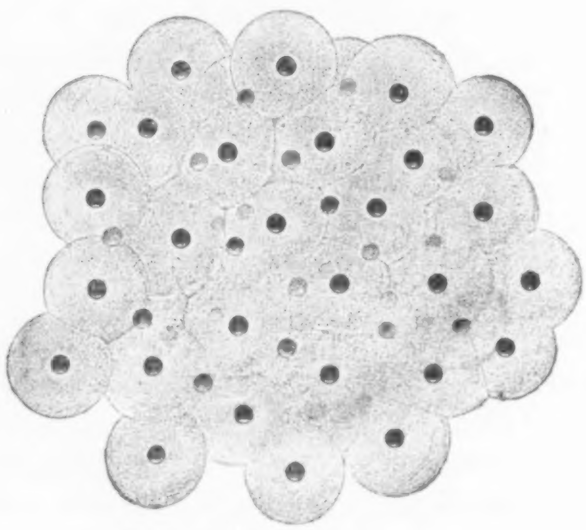
Eggs of *Bufo*.

rately the system based upon the perfect animals, although here and there the modifications are of unequal importance. We must bear in mind, however, that such a correspondence, if existing in the European Batrachians, is not universal. It is aptly added : "Larval forms such as the tadpoles are outside the cycle of recapitulation, the ontogeny being broken by the intercalation of the larval phasis."

Enough has been said to give some idea of the wealth of information given. As no other has had such opportunities of investigation as Mr. Boulenger, so no one has



Eggs of *Hyla.*



Eggs of '*Rana temporaria.*'

had greater capacity to use his material. Undoubtedly his monograph will long continue to be the standard of nomenclature. Nevertheless, there will be dissenters from some of the taxonomic ideas and some of the names adopted. For example, some may be disposed to differentiate the *Pelobates cultripes* from the genotype and call it *Cultripes provincialis* (with Cope) or *Cultripes cultripes.* Less likely will be the resurrection of *Ammoryctes* or *Epidalea.* Others too may assign higher value to forms designated as varieties of *Bombinator pachypus, Alytes obstetricans, Hyla arborea, Rana esculenta* and *Rana temporaria.*

Again, there may be differences of opinion as to various specific names. *Bombinator igneus* may be replaced by *B. bombinus* or possibly (but not probably) by *B. variegatus.* (The *Rana variegata* of Linnæus was supposed to be a foreigner 'at large'—'*habitat in exteris regionibus.*') For the *Bombinator pachypus* may be revised the name *B. salsus.* The toad may be called *Bufo bufo* or *B. rubeta.* The *Rana arvalis* may be deemed to be entitled to the Linnæan name *R. temporaria* on the ground that it was the species to which the name was limited in the Fauna Suecica. Then the *R. temporaria* of the Tailless Batrachians may be called *R. muta,* as by Camerano and Bedriaga. Finally, for the *R. agilis* the name *R. dalmatina* may be preferred. In reference to the last, Mr. Boulenger has noted, "the strict law of priority would require the adoption of this name * * *. However, this is one of those cases in which, it appears to me, conservatism is desirable." Mr. Boulenger adds: "Similar considerations have guided me in the naming of the two species of *Bombinator,* and I hope, in the interest of the stability of nomenclature, they will commend themselves to future workers."

But whether we agree with Mr. Boulenger or not in his views as to nomenclature, he certainly has given us a work which well deserves to be recognized as a standard and is alike meritorious for text as well as for illustrations. We may be allowed to hope that a companion volume on the remaining Amphibians of Europe will be published in time. From him who has given so freely, much will be expected.

Theo. Gill.

SKELETON LEAVES.

It has for a long time been known that the best method of skeletonizing leaves is to put them in a still pool containing moss, algæ or other living aquatic plants. In a few months, as a rule, all the softer portions of the leaf will disappear, leaving the vascular system perfectly clean from mesophyll and epidermis. The removal of the soft parts will take place more quickly if the leaves are killed before they are put in

the spring or pool. It has been supposed that the disappearance of the softer parts of the leaf was due to decay brought on by bacteria and fungi, and this may in some cases be true.

A few months ago some moss from a pool near the Great Falls of the Potomac was brought into the laboratory of the Division of Vegetable Physiology and Pathology and put into an aquarium. A few leaves of Norway maple affected with a spot disease were also put in to keep them fresh for a few days. It was soon noticed that the mesophyll and epidermis of the brown spots was disappearing, leaving nothing but the vascular bundles. A closer examination revealed numerous minute bivalve crustaceans belonging to the family Cyprididæ and as nearly as could be determined to the genus *Cypridopsis*, probably *C. vidua* (O. F. M.). The shells varied from 1/2 to 1 mm. long and half as broad and high. They are tumid, yellowish green and covered with short hairs. In swimming the plumose antennæ and bristly feet protrude from the shell and by their rapid movement cause the organisms to make a jerky rolling progress through the water or aid them in crawling. The mandibles and mandibular teeth are stout and well adapted for gnawing. (See Figs. A–D.) An examination of the alimentary canal of several of the organisms revealed the presence of numerous leaf cells, palisade and mesophyll, in the process of digestion. Little doubt could, therefore, remain as to the fact that the *Cypridopsis* were the active skeletonizers.

Another aquarium, however, was started, and decay-producing fungi and bacteria were introduced to see if they would alone produce skeletonizing.

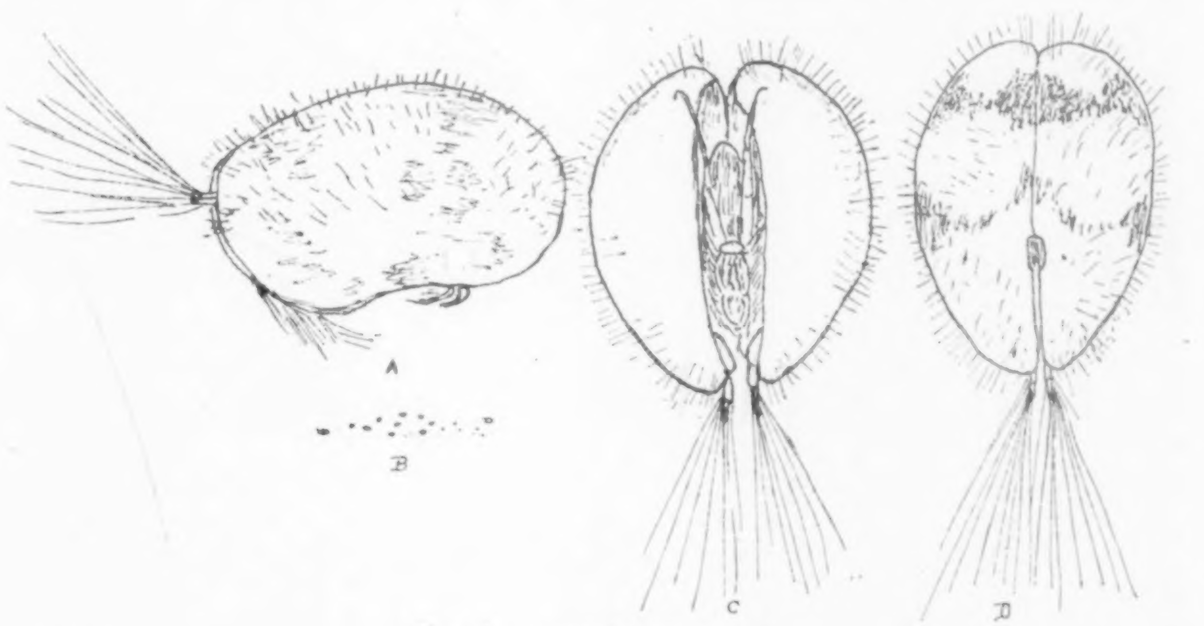


FIG. 1. CYPRIDOPSIS sp.

A. Side view × 50 diam. B. Natural size. C. Ventral view × 50 diam. D. Dorsal view × 50 diam.

Two sets of leaves of Norway maple, Peach, Rose, Elm, Linden and a number of other plants were selected. One set was put in the aquarium containing the *Cypridopsis* and the other put in the aquarium with fungi and bacteria. The process of decay went on very rapidly in the latter aquarium, but there was no sign of skeletonizing a month and a half after the experiment was started. In the aquarium with *Cypridopsis*, however, the work was begun almost immediately. The dead spots in the leaves were skeletonized in 24 hours, and

in six days large areas were cleaned. In four weeks the work was complete.

The little crustaceans will not attack any portion of the vascular system of the leaves mentioned until the mesophyll and palisade cells are all removed and other leaves with mesophyll are lacking. If they are starved, however, they begin on the finer bundles and soon destroy the specimen. It is best, therefore, when all the soft cells have been cleaned off from the bundles to remove the skeleton from the aquarium and press lightly between driers. The figure shows a maple and an ash leaf skeletonized in the experiment described.

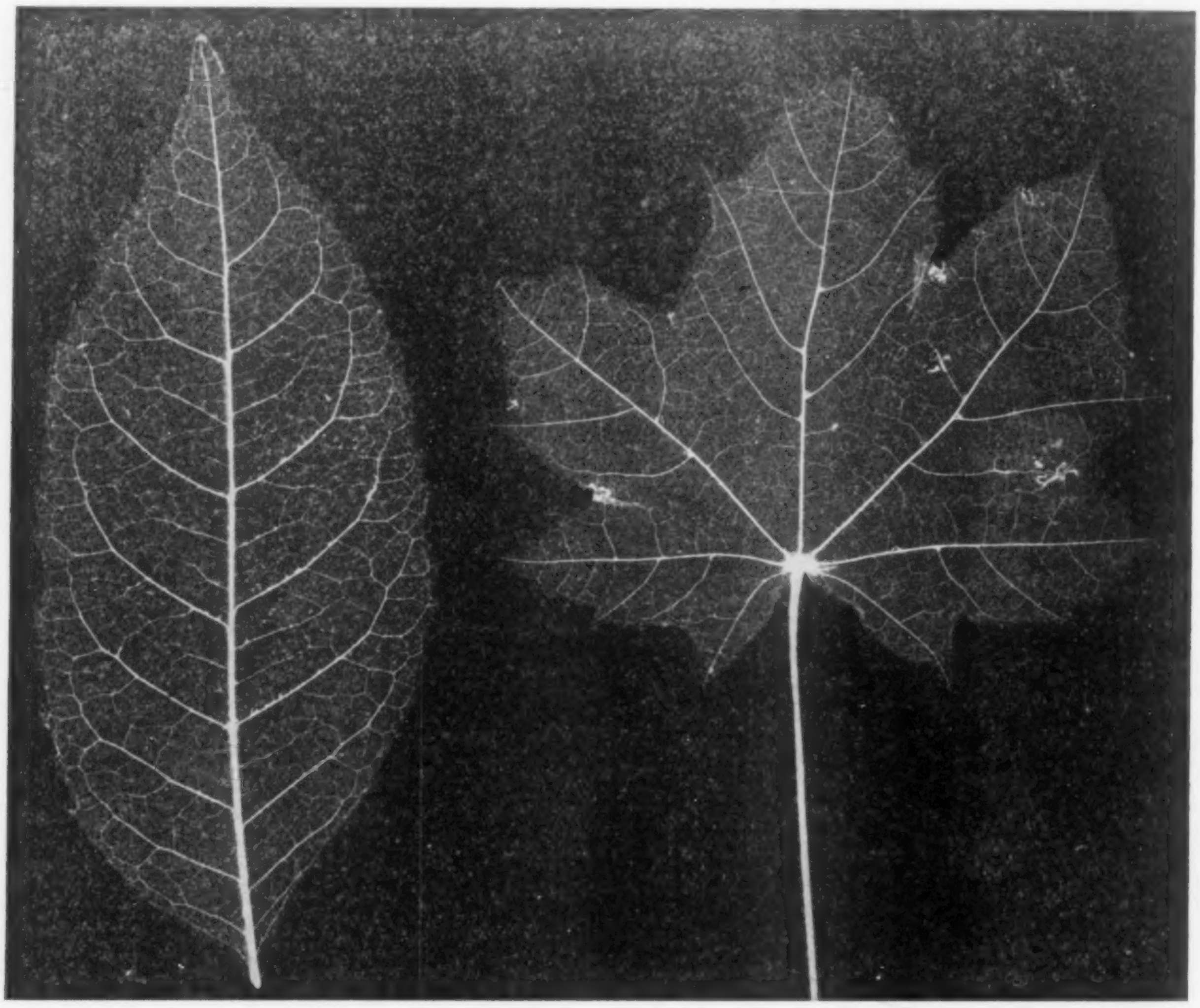


Fig. 2.

Cypridopsis and related genera are widely distributed in fresh and salt water. There is hardly a pool or pond in which some of them are not found. It is quite likely that the food habits of many of them, at least of of the closely related genera, are like the one here described.

Cypridopsis appears to thrive best in water kept fresh by the presence of algæ or other aquatic plants and not inhabited by fish or other animals which prey upon them. They are said, however, to live in dry mud, in a more or less dormant state for long periods.

Albert F. Woods,
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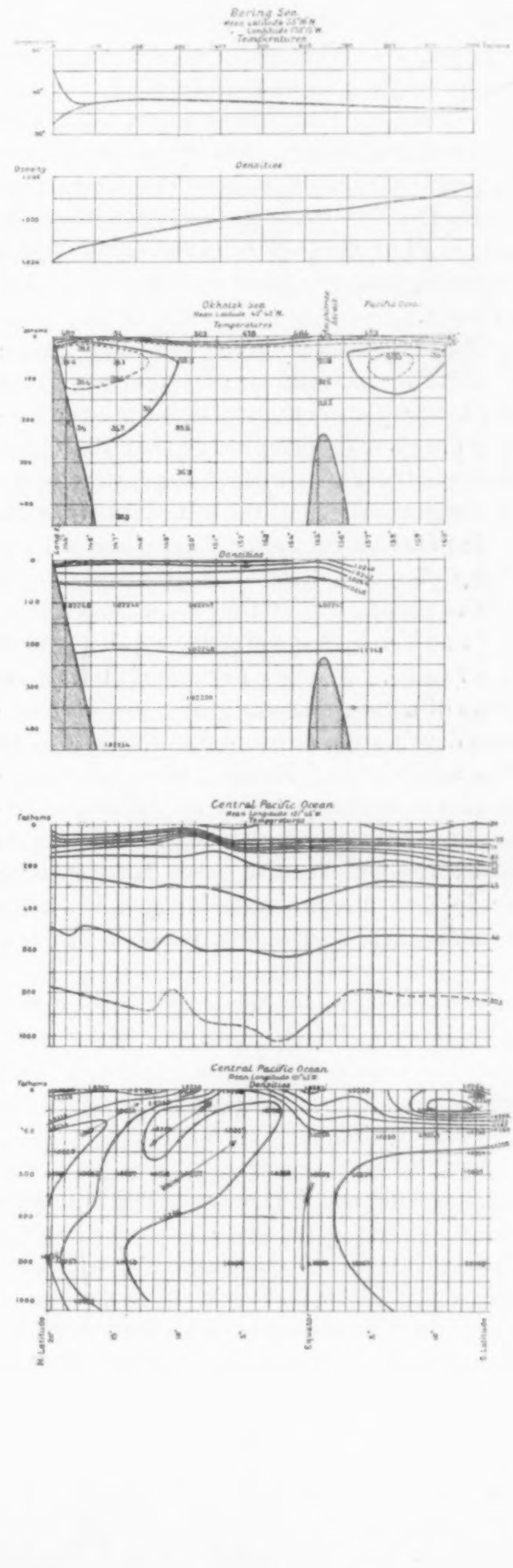
PROBLEMS OF PHYSIOGRAPHY CONCERNING SALINITY AND TEMPERATURE OF THE PACIFIC OCEAN.*

BERING SEA.

DIAGRAM No. 1 shows the mean temperatures and densities in the deeper parts of Bering Sea to the southward of the Pribilof Islands. It will be noticed that the density increases from 1.0241 at the surface to 1.0257 at the depth of 1,000 fathoms and according to a single observation to 1.0261 in 1998 fathoms at the bottom of the sea. We attribute the low density at the surface to a copious precipitation and to the discharge of several large rivers, notably the Yukon. This tendency towards a decrease of the density is counteracted by an undercurrent from the Northwest Pacific which carries a supply of salt. The relation of the Mediterranean Sea to the Atlantic Ocean furnishes an instructive illustration of the way in which salt and heat are conveyed from one sea to another; the same salt which is carried into the Mediterranean by a surface current is taken out again by a warm undercurrent which spreads out over an area extending from Gibraltar to beyond the middle of the Atlantic and, at the same time, sinks to depths below 1,500 fathoms. The Kuro Siwo, the great carrier of salt and heat in the North Pacific, does not, as a surface current, reach beyond 42 of Latitude, whence it passes northward beneath the surface, losing both heat and salt by its contact with colder and lighter water, and continues to sink as it advances until in the noted accumulation of salt in the deeper parts of Bering Sea we recognize the last traces of that warm and briny current. Lieut. Comm'dr Moser in 1896 found the depth of the channel between Bering Island and Kamchatka to be 3,117 fathoms instead of less than 500, as has been here-

*Abstract of a paper prepared for publication in the Annual Report of the U. S. Coast and Geodetic Survey for 1898 and *Petermann's Geogr. Mitt.*

Diagrams illustrating Temperature and Density of the Pacific Ocean



tofore assumed. We may admit that this great depth, as well as that of nearly 2,000 fathoms between Bering Island and the Aleutian Islands, to some extent facilitates the ingress of the waters of the Pacific, but in the matter of transfer of salt from one sea to another an ample supply of this substance is more essential than great depth of connecting channel. The Strait of Gibraltar, which, as we have seen elsewhere, regulates the density of not only the Mediterranean, but also of a large part of the Atlantic, has the moderate depth of 170 fathoms.

The temperature curve shows a minimum of 37°.5 in 100 fathoms; this indicates that the heat which is transmitted from the surface does not descend below that limit and that whatever heat we find at greater depths has been conveyed by the same undercurrent which carried the salt. There is considerable difference in the bottom temperatures of the great depths; they vary from 34° to 35° and are perhaps slightly below those of the Pacific. We fail to notice any indications of a constant temperature below a certain depth, such as we find in the Caribbean Sea and Gulf of Mexico, where the thermometer registers 39°.5 at all depths exceeding 700 fathoms. The observations on which the temperature curve is based were made about the middle of August, when the summer heat had nearly reached its maximum; the broken line indicates the probable conditions at the end of February, when the surface temperature is supposed to remain near the freezing point of fresh water.

THE OKHOTSK SEA.

IN the Diagram giving an east and west section through the Okhotsk Sea we notice in the western part the existence of a thick layer of very cold water at a short distance below the surface, covered by a stratum of very low density but of comparatively high temperature. When we recall that sea water does not commence to congeal until its temperature is reduced to below 29° this cold layer furnishes an indication of the severity of a Siberian winter, when the whole of Okhotsk Sea is frozen over. The low density of the surface water is due to the fact that it is composed partly of melted ice, which does not contain much salt, and partly of river water, particularly that of the Amur, which, after rounding the northern point of Saghalin Island, floats southward along its eastern shore. It is rather surprising to find such steep gradients in the temperatures as 54° at the surface and 31° in 26 fathoms, and they can be accounted for only by assuming that there are no strong currents which keep the water agitated, and furthermore that, whatever the increased percentage of salt in consequence of evaporation may be, it is too small to sink the surface water to any considerable depth.

There are no temperature observations available for the water under the surface in the eastern part of Okhotsk Sea except bottom temperatures; we conjecture that during the winter months there is but little difference between the temperatures of the eastern and western part. In the height of summer, however, we may expect to find about 35°.2 the lowest temperature at a depth of about 100 fathoms in the eastern part. At greater depths a slight increase of temperature is noticed, 36°.3 is recorded at 328 and 437 fathoms, and there appears to be a nearly uniform temperature of 36° in the great depths of the basin, which, according to Moser's soundings in 1896, has the shape of a trough with a steep slope from the Kuril Islands, and depths exceeding 1,800 fathoms. The densities increase from 1.0222–1.0240 at the surface to 1.0246 at 55 fathoms and 1.0248 at 219 and 1.0254 at 437 fathoms. These relations of density and temperature are similar to those of Bering Sea, showing a continuous increase of density from the surface downward and

the existence of a minimum of temperature at the depth of about 100 fathoms, separating the much warmer surface waters from the slightly warmer deeper waters. Hence Okhotsk Sea, like Bering Sea, must receive a supply of salt and heat from a connecting sea by a current which starts at the surface and during its progress gradually sinks to the greatest depths. The Okhotsk Sea connects with the Japan Sea by La Pérouse Strait and with the Pacific by the Passages through the Kurils, and it may receive its supply of salt from either of these seas, but the observations by Makaroff in 1887 and Moser in 1896 point towards the Japan Sea as the source. Makaroff found in La Pérouse Strait three kinds of water, each of a distinctive physical character. In the southern part he found dense and warm water, with indications that it was from the Japan Sea on its northward way. In the northern part he found warm and light surface water similar to that we encounter farther north, off the shore of Saghalin Island; it is probably composed of melted ice and the waters of the Amur and other rivers which have come down from the northward along Saghalin Island. This surface water rests on water which has considerable density but a very low temperature; it is of the same character as that cold stratum which we found underlying the warm surface waters in a higher latitude, and we may, therefore, conclude that along the entire eastern shore of Saghalin Island the water below the depth of 25 fathoms receives but a small increase of temperature in consequence of the summer's warmth. Where it meets the water from the Japan Sea it rises to the surface in a streak which extends from Cape Crillon forty miles in a southeasterly direction, effectually shutting off the Japanese current from the western part of Okhotsk Sea. Moser's density observations show that this current advances northward in the eastern part of the Sea, passing along the Kuril Islands, and that it is gradually overlapped by the lighter water to its left, thus verifying Makaroff's views, according to which the waters from the Japan Sea, after reaching the Okhotsk Sea, continue to sink until they occupy all the deeper parts of this basin. The depth of La Pérouse Strait is but 35 fathoms. The passages through the Kurils are probably much deeper. Makaroff gives 235 fathoms for the Amphitrite Strait, and from Moser's temperature observations, we infer that about 800 fathoms' depth may be carried from the Pacific into the Okhotsk Sea. From this we may conclude that, if the Okhotsk Sea does not receive a supply of salt and heat through an undercurrent from the Pacific, it is not on account of an insufficient depth of channel, but due to a greater difference between the physical condition of the waters of the Okhotsk Sea and those of the Japan Sea than exists between the former and those of the Pacific adjoining. The cold zone along the Kuril Islands was formerly thought to be due to the effect of cold currents which were supposed to come from the neighborhood of Kamchatka, but Makaroff correctly attributes the low temperature to a commingling of the cold water from lower strata with the surface water. There are instances where cold water rises to the surface in consequence of peculiar conditions of density and temperature, as in the case of the cold streak at the equator off the west coast of South America; but in the present case an inspection of the diagram will show that the rising is confined to the upper stratum of 25 fathoms' depth, and that it should be attributed to the bottom configuration, which offers formidable obstructions to the movements of a formidable tidal current sweeping through the passages four times a day.

THE CENTRAL PACIFIC OCEAN.

THE Diagram shows a section of the Pacific

Ocean in the tropics along the meridian of 151° 45′ W., a short distance to the eastward of the Hawaiian Islands. The surface densities in this section, and generally in the South Pacific, are higher than in the North Pacific; this is due mainly to the fact that no large rivers, draining extensive continental areas, empty their waters into the South Pacific. As a rule the densities decrease from the surface to the depth of about 300 fathoms, where densities from 1.0254 to 1.0257 are found; thence there is a very gradual increase to the bottom, where 1.0259 is reached. This depth of 300 fathoms indicates the approximate limit to which salt and heat are carried through the process of surface evaporation. But there is another cause which brings the waters of the ocean into motion and tends to diffuse salt and heat into regions which are not affected directly by evaporation. If two differently constituted bodies of seawater meet under the conditions of equilibrium, the one composed of dense and warm, the other of light and cold water, an effort towards equalization of the proportions of salt and heat at the plane of contact will develop a tendency in the denser water to sink and in the lighter water to rise to a higher level. The waters of the South Pacific, being denser and warmer in the upper stratum than those of the north Pacific, exhibit this tendency to sink in the vicinity of the equator, where with a density of 1.0259 to 1.0260 at a depth of 200 fathoms they descend to more than 1,000 fathoms' depth. At the same time the light water of the north Pacific rises from the depth of 800 fathoms in latitude 20° N. with a density of 1.0254 in an oblique direction towards the equator, arriving in latitude 3° N. with a density of 1.0258 at 50 fathoms from the surface. The effects of the sinking of the dense and the rising of the cold water are shown in the diagram of temperatures by the high temperatures between the equator and 10° N. latitude at all depths exceeding 150 fathoms and by the existence of a minimum of surface temperature at the equator itself. We note a second example of bodies of water changing their level in the upper left-hand part of the diagram, where dense and warm water from the region of the equatorial counter current undermines the north equatorial current and forces its light and cold water towards the surface. The diagram has the defect of showing motion in only two directions, vertical and meridional, while the third component, the most important one, that in an east-and-west direction is not represented and hitherto has not received our attention. The presence in the south Pacific of water at the depth of 100 fathoms with greater density than is found at the surface cannot be accounted for by mere sinking 'in loco,' but we have to assume that the surface water has drifted to its present position by a current from the eastward, while the lower water comes from a more southerly direction. Likewise, we find in latitude 9° 28′ N. the density of the surface water is 1.0250, and is nowhere less than 1.0256 under the surface; as we cannot admit that in a region where density decreases with depth water rising to the surface should have its density reduced, we must assume that the lightness of the surface water is either due to precipitation or to a current of light water, the north equatorial, and that the water of the density of 1.0256 may not reach the surface, or, if at all, then probably far to the westward of the position indicated on the diagram.

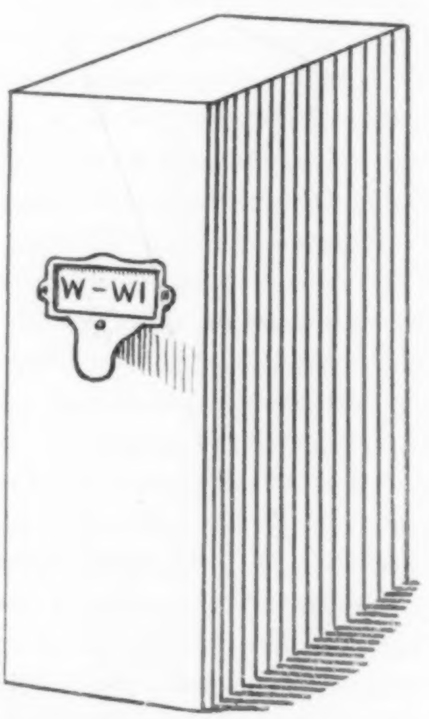
A. Lindenkohl.

THE STORING OF PAMPHLETS.

The question of the best method of keeping pamphlets in a private library has become a question of great practical importance to the scientific worker. Owing to the custom of exchanging reprints of arti-

cles, it has come about that the larger part of a working scientific library is very apt to consist of separate pamphlets, which soon run up into the thousands in number. Many expedients have been suggested for arranging these so as to keep them always in strict order and at the same time readily accessible. The use both of drawers put in a cabinet, and of various forms of boxes, has been proposed from time to time, and each of these suggested plans has had something to recommend it.

I have now been using for some time a form of box which seems to me, on the whole to combine a larger number of advantages for the preservation and ready accessibility of one's pamphlets. This box is made of thin wood, and measures inside 7x4 inches, and is $10\frac{1}{2}$ inches in height. It is entirely



open at the back, and is covered with a cheap grade of marble paper. Pamphlet boxes of this form are furnished in quantity at low rates by the Library Bureau.* By simply adding to each of these a pull and label holder, as shown in the figure, we obtain a box which may be placed on a shelf of an ordinary book-case, and which may be easily pulled out from its position with one hand, leaving the other hand free to look over the pamphlets which it may contain. The label may be easily shifted in the holder, if the contents of the pamphlet-box are to be changed. These boxes may be arranged in rows upon a shelf, and then present a neat and orderly appearance, and whenever one box becomes too full another box may be interpolated in the series without difficulty.

* The Library Bureau, 530 Atlantic Ave., Boston, Mass.

As regards my own system, I arrange the boxes in two sets. In one of these sets the pamphlets are arranged alphabetically according to the author, and in this series I include all such publications as refer to my special line of study. In a second set each box is devoted to a special subject, and here are placed pamphlets which I have less frequent occasion to refer to. I find it also very convenient to keep journals and magazines in these boxes, a separate box for each magazine. These serials are then kept in good order, are protected from dust and are readily accessible.

In conclusion, I will only say that, after having experimented with many systems, I have found this the most simple, convenient and economical, and, therefore, on the whole, the most satisfactory of any which I have tried.

CHARLES S. MINOT.

NOTES ON INORGANIC CHEMISTRY.

THAT there is a decided resemblance between the compounds of oxygen and halogen salts with ammonia, and the compounds of these same salts with water was long ago pointed out by Professor H. Rose. This fact is further developed by Mendeleef in his 'Grundlagen der Chemie,' and attention is there called to the fact that many of these salts give up a part or the whole of their ammonia in a very similar way to that

in which they give up their water of crystallization. A typical example is copper sulfate, which not only forms the compounds, $CuSO_4$, $5H_2O$ and $CuSO_4$, $5NH_3$, but also the four intermediate compounds, $CuSO_4$, $4H_2O$, NH_3; $CuSO_4$, $3H_2O$, $2NH_3$; $CuSO_4$, $2H_2O$, $3NH_3$ and $CuSO_4$, H_2O, $4NH_3$, so that the replacement of water by ammonia is not a mere figure of speech. In the last number of the *Zeitschrift für anorganische Chemie*, Fritz Reitzenstein takes up the replacement of water by other nitrogen bases, especially pyridin, and shows that a large number of salts form similar compounds with pyridin, as with water of crystallization. Some of these were known before, but twenty-eight new ones are described, as well as several compounds in which quinolin replaces the water of crystallization. A table is appended to his paper giving several hundred of the known hydrates, ammonia compounds and pyridin compounds in juxtaposition, and the resemblance of the typical members of each group is striking.

IN the previous number of the *Zeitschrift*, Reitzenstein's 'Habilitationschrift' is published, which is a very complete history of the different theories of the constitution of the metal-ammonia salts. The first notices of the combinations of certain salts with ammonia date back to Bergman and Tassaert in the last century, but no particular attention was attracted to them until the discovery of the first platinum-ammonia compound by Magnus in 1828. This was quickly followed by the preparation of new platinum bases by Gros (1838), Reiset (1840–1844), Peyrone (1844), Raewsky (1847) and Gerhardt (1850). As early as 1841 Berzelius attempted to explain their constitution according to his general theory of salts, but Claus was the first who held the view accepted to-day that the ammonia is present in the compound as the NH_3 group. This was brought into accord with the valence theory by Jörgensen, of Copenhagen, who has been the most prolific worker in the metal-ammonia compounds, and until recently his views, which represent the ammonia groups as united with each other, as $-NH_3-NH_3-NH_3-NH_3-$, has been generally accepted. Here the ammonia is often replaced by water, in which case the oxygen is looked upon as quadrivalent. In some series, as among the platinum and cobalt bases, isomers are met with, and some of them are difficult to account for by Jörgensen's theory. Within the present decade Alfred Werner, of Zurich, has proposed a new theory, which represents the atom of the metal as in the center of an octahedron, surrounded by six other atoms or groups (as NH_3 or H_2O), one at each angle. In some cases there are but four attached atoms or groups, in which case the configuration can be represented as on a plane with the metal atom in the center of a square and one group at each of the four angles. This complex is supposed to have a certain amount of combining power as a whole, and unites with negative or positive elements to form salts. Werner carries this theory out in application to many other classes of salts, as, for example, sulfuric acid, where the complex SO_4 is united with two atoms of hydrogen; potassium permanganate, where the complex MnO_4 is united to one atom of potassium; $(HgCl_4)K_2$, $(PtCl_6)K_2$, $(SiF_6)K_2$, etc. The idea of valence is not wholly abandoned, but is not adhered to in the formation of the complex. The theory is too new to prophesy whether it will meet with general acceptance, but in its application to the platinum and cobalt bases it explains much that is difficult to account for on the valence theory as ordinarily accepted. Reitzenstein's paper and recent papers by Werner should be consulted for the full explanation of the theory.

IN this connection it may be noted that the resemblance of water to ammonia is not

confined to such cases as those mentioned. The production of liquid ammonia in quantity has led to its investigation as a solvent, in which it resembles water to some considerable degree. Salts render it a conductor of electricity and a similar dissociation seems to take place as in aqueous solution. In the December number of the *American Chemical Journal* E. C. Franklin and C. A. Kraus record the solubilities of something over five hundred substances, inorganic and organic, in liquid ammonia in which many analogies with water are shown. They also give the determinations of molecular rise in boiling-point of liquid ammonia for twenty-nine different substances.

J. L. H.

CURRENT NOTES ON METEOROLOGY.

UPSALA CLOUD OBSERVATIONS.

THE first publication embodying the results of the International Cloud Observations comes from Upsala, where Dr. Hildebrandsson carried on the work during the International Cloud Year (May 1, 1896–May 1, 1897). According to *Nature* (Dec. 1) nearly 3,000 measurements of heights and velocities were made, 1,635 of which were made by means of photography. The annual variation of the mean heights of the clouds is very marked, the maximum coming in June and July, and the minimum in the winter. During the summer the mean height of the cirrus is 8,176 meters, and of the cumulus 1,685 meters. The heights of the upper and middle level clouds are lower than at Blue Hill Observatory. The velocity of all the clouds is greater in winter than in summer.

RECENT ANEMOMETER STUDIES.

AT the meeting of the Royal Meteorological Society, held in London, November 16th, a report on the exposure of anemometers at different elevations was presented by the Wind Force Committee. The experiments were carried out by Dines and Wilson-Barker, on board H. M. S. *Worcester*, off Greenhithe. Five pressure-tube anemometers were employed, the first being at the mizzen royal masthead; the second and third at the ends of the mizzen topsail yard-arm, and the fourth and fifth on iron standards 15 feet above the bulwarks. The results show that the ship itself affected the indications of the lower anemometers, while some low hills and trees, which were a quarter of a mile away from the ship, to the south and southwest, also affected the wind velocity from those quarters. The Committee are of the opinion that the general facts deducible from these observations bearing on the situation of instruments for testing wind force are: (1) That they must have a fairly clear exposure to be of much value, and it would appear that for a mile, at least, all around them there should be no hills or anything higher than the position of the instruments. (2) That on a ship the results may be considered fairly accurately determined by having the instrument 50 feet above the hull, but that on land it will generally be necessary to carry the instrument somewhat higher, to be determined entirely by local conditions. (3) That no other form of anemometer offers such advantages as the pressure-tube, from the fact that it can be run up and secured easily at this height above a building, and that the pipes and stays can be so slight as to offer no resistance to the wind or cause any deflecting currents.

SAN FRANCISCO RAINFALL.

A PAPER by Marsden Manson in the October number of *Climate and Crops, California Section*, concerns the seasonal and monthly rainfall at San Francisco from 1849 to 1898. In this period of forty-nine years the normal annual rainfall has been 23.4 inches. Fluctuations have occurred between an annual rainfall of 7.4 inches in 1850–51, and

of 49.2 inches in 1861–62. The rainfalls of the winters of 1850–51, 1862–63, 1863–64, 1870–71, 1876–77 and 1897–98 have been the smallest, averaging 10.8 inches. Five seasons have had an average rainfall of 40.89 inches, viz., 1852–53, 1861–62, 1867–68, 1877–78, 1889–90. The variations in winter rainfall are stated to be due primarily to the changes in the positions of the lines upon and along which the areas of low pressure originate and move in their course from the North Pacific Ocean into the interior of the continent.

FREQUENCY OF RAINY DAYS IN THE BRITISH ISLES.

THE British rainfall records for the period 1876–1895 have been studied by Scott, in order to determine the frequency of rainy days in the British Isles (*Quart. Journ. Roy. Met. Soc.*, Oct., 1898). Charts have been drawn showing the mean monthly frequency of rainfall in percentages. The greatest excess of frequency is always on the extreme north and west Atlantic coasts. The highest figures of all are found at Dunrossness (Shetland) and at Stornoway in most months, especially in the late autumn and winter. In summer the figures for the west of Ireland are higher.

R. DEC. WARD.
HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

MAN AND MONKEY.

UNDER the title 'L' Homme et le Singe,' the Marquis de Nadaillac, in the *Revue des Questions Scientifiques*, October, 1898, gives a thorough and searching criticism of the alleged descent of man from the anthropoids. He points out forcibly how many assumptions, without positive support, underlie the general theory of evolution, and especially the evolution of man from any known lower type. At the same time, he does not pretend that our present knowledge is decisive, either for the negative or the affirmative. "At the present time," he says, "in view of what is actually known, we are not prepared to deny the possibility of any such theory; but, I hasten to add, we are just as little prepared to affirm it as a truth." Such caution is certainly in season, as the tendency is constant to hasty conclusions.

THE NATIVE TRIBES OF COSTA RICA.

AN interesting contribution to the anthropology of Costa Rica has recently been published by Dr. H. Pittier (*Razas Indigenas de Costa Rica*, 1ª Contribucion, November 1898). He furnishes a number of anthropometrical data of the Guatusos Indians and a newly collected glossary of their language. Diagrams of their feet and hands are added. There are wide variations in all the physical measurements, illustrated by the pulse-rate, which varies from 58 to 87, and by the skull-form, which is dolicho-, meso- or brachy-cephalic. Dr. Pittier concludes, "that it is not possible from these data, which display such marked divergences, to establish a definite type for the race." The vocabulary is especially useful for the careful study of the sounds of the language which accompanies it.

THE CHRONOLOGY OF ARCHÆOLOGY.

FEW questions in pre-historic archæology are of greater interest than the means of determining the positive chronology of its various epochs and periods. A distinctly valuable contribution to this point is one by Dr. Robert Munro in the *Archæological Journal*, September, 1898, entitled 'The Relation between Archæology, Chronology and Land Oscillation in Post-glacial Times.' He assumes the probability of the astronomical theory of glacial causation and also the generally admitted opinion that the maximum cold in each glacial period coincided with the maximum submergence of land. With these as guides, he reviews the evi-

dence for submergence in a number of localities in Europe, and concludes that the amelioration of the climate began about 30,000 years ago, 'which synchronizes with the astronomical calculations to marvellous nicety.'

ETHNOGRAPHY OF GERMAN EAST AFRICA.

THE Germans set a good example by their investigations of the native tribes in their newly acquired possessions. An instance of this is an article by Dr. F. von Luschan on the Wassandaui, Warangi, Wambugwe and neighboring peoples of German East Africa. It is amply illustrated and presents a clear idea of their general stage of culture. Among other curious facts mentioned is one explaining the rapid diminution of the tribe known as the Watatura. The men of this tribe are industrious and accustomed to do the work which in neighboring tribes is performed by the women; hence, they are in great demand in these tribes as husbands, and, as the rule is that they follow their wives, their own tribe diminishes. (*Beiträge zur Ethnographie des abflusslosen Gebiets von Deutsch-Ost-Africa*, Berlin, 1898.)

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

TWELVE scientific societies, representing more than half of the most important scientific work accomplished in America, are beginning their meetings at Columbia University as we go to press. We have already called attention to the dates and other arrangements for these meetings, and full reports of the proceedings of the different societies will be given in subsequent issues. The address of Professor Bowditch, President of the American Society of Naturalists, is published in this number, and other important addresses and papers will follow.

THE International Astronomical Society appears to have held a successful meeting at Buda-Pesth, though it scarcely deserves the name 'international' when American, English and French astronomers are unrepresented at its meetings. The existing organization might, however, be developed so that international congresses could be held as important as those in mathematics, zoology, geology, physiology and psychology.

A CABLEGRAM from London announces that Lord Iveagh (Edward Cecil Guinness) has presented to the Jenner Institute of Preventive Medicine, London, the sum of £250,000, in aid of scientific research in bacteriology and other branches of biology, concerned with the cause, nature, prevention and treatment of disease.

THE Regents of the University of the State of New York have decided to divide the work in geology and paleontology which was for so many years in charge of the late Professor James Hall, and in so doing have erected two coordinate departments, one of paleontology and stratigraphic geology and the other of 'pure geology,' the latter to cover dynamic and physical geology, the crystalline rocks, surficial geology, etc. They have appointed to the charge of the former Professor John M. Clarke, with the title of State Paleontologist, and to the latter Dr. F. J. H. Merrill, with the title of State Geologist. They have also appointed Dr. E. P. Felt to the position of State Entomologist as successor to the late Dr. J. A. Lintner.

PROFESSOR E. B. WILSON, of Columbia University, whose departure for Europe on a year's leave of absence we recently announced, intends to visit the Nile region in order to study, if possible, the embryonic stages of the African ganoid *Polypterus*, the supposed ancestor of the Amphibia. Those who read Dr. Harrington's article in this JOURNAL will remember that he and Dr. Hunt found this fish in the Nile last summer, but were unable to wait for the breeding season.

M. GRAVIER has been made Assistant in the Paris Museum of Natural History in the room of the late M. Bernard.

THE University of Marburg has conferred the degree of Ph.D. *honoris causa* on Professor J. M. Clarke, of Albany.

PROFESSOR ERIC GERARD, of the University of Liège, known for his contributions to elec-

tricity and magnetism, has been admitted to the Belgian order of Leopold.

THE Paris Academy of Sciences has awarded the Desmazières prize to Dr. J. B. de Toni for his *Sylloge Algarum*.

THE Paris Anthropological Society has chosen Dr. Capitan as President for 1899.

DR. J. KOLLMAN, professor of anatomy in the University of Bâsle, has been elected a member of the Munich Academy of Fine Arts.

SIR WILLIAM JENNER, F.R.S., the eminent physician, died on December 11th, in his eighty-third year. He was for many years professor, first of pathological anatomy and later of medicine, at University College, London. He had published works on fevers and other subjects.

THE death is also announced of M. Jacques Passé, an assistant in the laboratory of physiological psychology at the Sorbonne, Paris, known for his researches on the sense of smell, etc.

THE death of Mr. Hayter Lewis, formerly professor of architecture in University College, London, deserves mention in this place, if only because he was one of the first to recognize relations between sanitary science and architecture. We also regret to record the death, at the age of 73, of M. Laboulbene, since 1879 professor of the history of medicine and surgery, at Paris.

THE Paris Exposition of 1900 will include a museum of the history of chemistry. It will include apparatus, products of chemical laboratories, plans, portraits of investigators, etc.

IT is stated in *Nature* that an informal committee will shortly meet in Calcutta to consider the reports by the Astronomer Royal and Sir Norman Lockyer, who were recently asked for advice regarding Indian astronomical and solar observatories. The future working of these observatories will be discussed, and Sir James Westland, Messrs. T. Holderness and J. Eliot, and General Strahan, Surveyor-General, will probably be members of the committee.

MR. MICHAEL LAKIN'S donation of a large Liassic *Ichthyosaurus* to the British Museum, says *Natural Science*, has necessitated a considerable rearrangement of the existing collection. We understand that the old cases are to be removed, while the fine slabs containing these fossils will be simply covered with glass and exhibited upon the wall. Space is to be gained by raising a number of the specimens above the top of the present wall-cases.

IT appears that the School of Tropical Medicine, at London, to which we have several times recently called attention, will receive a subsidy from the British Treasury on behalf of the Protectorates under the administration of the Foreign Office.

CAPTAIN BORCHGREVINK'S expedition, which left London on August 3d, has started from Hobart, Tasmania, for the Antarctic regions.

GENERAL VÉNUTCOFF announces that a Russian expedition will shortly leave for Spitzbergen to make geodetic and astronomical observations.

THE steam yacht *Utowana* left New York on December 24th for Yucatan on the botanical expedition to which we have already called attention. Dr. C. F. Millspaugh, of the Botanical Department of the Field Columbian Museum, is in charge, and the party includes Mr. A. V. Armour, the owner of the yacht.

Nature states that owing to the unique and extremely interesting nature of the fauna in Lake Tanganyika, the study of which was recently the object of an expedition supported by the Royal Society, and led by Mr. J. E. S. Moore, a committee has been formed, consisting of Sir. John Kirk, G.C.M.G., K.C.B., F.R.S. (late British Resident at Zanzibar); Dr. P. L. Sclater, F.R.S. (Secretary of the Zoological Society); Mr. Thiselton-Dyer, C.M.G., F.R.S. (Director of the Kew Gardens); Professor Ray Lankester, F.R.S. (Director of the Natural History Departments of the British Museum), and Mr. G. A. Boulenger, F.R.S. (of the British Museum), for the purpose of organizing another expedition to the same regions, to thoroughly survey the basin, not only of Lake Tanganyika, but also the unknown portions of the northern extension of the great series of valleys in which Tanganyika, together with Lakes Kivu and the Albert Nyanza, lie ; to collect specimens of the aquatic fauna and flora and to study the geological history of this part

of Africa. The sum of £1,000 has been subscribed from one source towards the expenses of the expedition, which are estimated at not less than £5,000.

THE Washington Academy of Medicine held its sixth annual meeting on December 14th, when Dr. Samuel C. Bussey delivered the presidential address, on 'The History and Progress of Sanitation of the City of Washington and the Efforts of the Medical Profession in Relation Thereto.'

THE New England Association of Chemistry Teachers will hereafter publish records of its meetings. We have received a report of the nineteenth meeting, held in Boston on November 12th. Dr. H. M. Goodwin, of the Massachusetts Institute of Technology, read a paper on the advance in physical chemistry during the last decade, and a report was presented on the progress of the movement instituted by the Association to promote efficiency in the teaching of chemistry.

THE second annual convention of the directors of physical education of the colleges and universities of the United States will be held at Columbia University, New York, on December 30th.

M. DUSSAUD, of Geneva, has sent the Paris Academy of Sciences a description of a new telephone with which he has successfully experimented. From a distant laboratory he was able to send messages that could be distinctly heard in a large room by an audience of 1,000 people.

MR. A. B. BAKER, of the National Zoological Park, notes that the large snakes refuse to eat rats captured about the buildings, but quickly devour those caught out of doors. Rats taken indoors were then kept for a day or so in a cage with an earth floor, after which they were readily eaten. A very similar experience was had with smaller snakes, copperheads, these declining to eat house mice, permitting them to run about the cage, or even over their bodies, with impunity, while field mice were quickly taken even after they had been dead for some little time. These facts seem to show that snakes have a very keen sense of smell and are largely guided by it in the choice of their food.

PROFESSOR BEHRING, in conjunction with Dr. Ruppel, has applied for a German patent for a tuberculosis serum : 'A method for producing a highly poisonous and immunifying substance from tubercle bacilli or from cultures of tubercle bacilli.'

THE Prince of Wales presided at a private meeting at Marlborough House, on December 20th, convened by him to promote a war against tuberculosis. The Marquis of Salisbury, the Earl of Rosebery and a number of men of science and physicians spoke on the urgent necessity of educating the people in the means of preventing consumption and of checking the spread of tuberculous disease among cattle.

REUTER'S agency states that advices from the Russian provinces of Livonia and Courland report that leprosy is spreading to a marked extent. The military authorities in these districts have been compelled to reject for the army many young men found to be infected with the disease. Notwithstanding the precautions taken, the number of victims amounts at the present time in Russia to more than 5,000.

GIVING evidence before the Plague Commission, at Bangalore, on December 12th, Colonel Robertson, the Resident at Mysore, stated, according to the London *Times*, that the attitude of the people was uncompromisingly hostile to the plague measures. It was impossible in the large cities to deal effectively with the epidemic, the fear of which destroyed natural affection. Captain Roe, chief plague officer, maintained that segregation was unsuccessful, owing to the difficulty of catching the people; if segregation were abolished the natives would not run away. Major Deane declared that Yersin's serum was useless. Haffkine's serum, he said, conferred a temporary immunity, but not to the extent supposed. Colonel McGann stated that the plague had been prevalent among native soldiers, but not among the Europeans. Haffkine's prophylactic had been found valuable. The plague was in the middle of December again increasing in Bombay city, but a decrease was reported in the Presidency districts. Madras, Mysore and Haidarabad remain unchanged, but a number of cases have occurred in the Central Provinces.

WE learn from the *British Medical Journal* that the Nizam's government has sanctioned the immediate construction of a complete and thoroughly-equipped Pasteur Institute for Haiderabad. It will adjoin the hospital and medical school, and will be available in about six months for patients. The Colombo Pasteur Institute, which is being constructed near the Lady Havelock Hospital out of funds towards which Mr. J. W. C. De Soysa contributed 10,000 Rs. in memory of his father, is approaching completion, and will be opened probably early next year. Meanwhile the Pasteur Institute for India hangs fire, and the delay is calling forth some expression of impatience on the part of subscribers.

DR. CROSBY, of the New York City Board of Health, has given out the following statistics of deaths from influenza in the city:

	1890.	'91.	'92.	'93.	'94.	'95.	'96.	'97.	'98.
Jan	264	1	281	5	71	242	16	10	—
Feb	30	—	109	4	33	165	18	28	8
March.....	12	45	50	47	29	84	17	64	19
April	3	507	20	86	16	44	26	51	16
May.......	1	123	13	30	5	15	5	21	2
June	2	34	3	9	6	2	—	4	2
July	—	4	1	—	4	—	1	1	2
August ...	—	3	—	—	1	1	1	—	—
Sept.......	—	—	—	2	—	—	—	2	—
Oct.	—	4	—	4	4	2	2	2	—
Nov........	1	4	13	5	6	4	4	3	12
Dec.	1	129	5	35	13	8	11	10	?
Totals..	314	854	495	227	188	567	101	196	58

The mortality attributed to other sources has also been greatly increased during epidemics of 'the grip.' It appears that the disease grows in severity for two or three months, and the outlook for New York and other cities is consequently unfavorable. Until December, 1889, when the disease was imported from Europe, having apparently traveled from China to Russia, there had been no epidemic since 1849.

THE question has of late been often raised among professional men whether it would not be wise and practical to seek to evade many of the difficulties and objections arising from the employment of 'experts' by litigants on both sides, leaving Court and jury to gather the essential facts and the technical merits of the case, as best they can, from prejudicial and admittedly partisan testimony, the usual suggestion being the appointment by the Court of its own experts. We find in '*Der Ingenieria*' of Buenos Ayres, 1898, pp. 91–102, an account of the investigation of the cause of a steam boiler explosion by the National Railway Board, in the course of which a detailed report was submitted by independent experts appointed by the Courts. It would seem that Argentina has progressed further in this direction than the United States.

PROFESSOR H. H. TURNER, of Oxford University, makes the breaking of windows at the Observatory by small boys the occasion of a renewed appeal for a house for the director in the park near the Observatory. He says: "It was in the last few months of my chief assistantship at Greenwich that the anarchist Bourdin made his attempt to blow up the Royal Observatory; and the attempt, unsuccessful as it fortunately was, could not fail to impress those immediately concerned as to the necessity for carefully protecting an observatory isolated in the middle of a park. I do not wish to compare the mischievous boyish freak of yesterday with this grave and dastardly outrage; but there is this common to the two—that the opportunity was selected with reference to the absence of people from the spot. Bourdin selected a time when the Astronomer Royal was away and the staff would ordinarily have left the Observatory (though, as a matter of fact, one or two were on the spot, having stayed beyond the usual closing hour to finish some work); the boys with catapults found Sunday afternoon a good time to use them."

UNIVERSITY AND EDUCATIONAL NEWS.

THERE seem to be difficulties in arranging for the accommodation of the University of London, in the buildings of the Imperial Institute. In the meanwhile the Council of University College have notified the Statutory Commisson that they are prepared to consider placing the land, buildings and endowments of the College at the complete disposal of the Commission.

AN organization, 'La société des amis de l'Université,' has been formed in Paris and adopted a constitution on December 11th. The object of the Society is to aid in the development of the University of Paris, by forming new chairs, assisting the laboratories, establishing scholarships, prizes, etc. It is proposed to issue a bulletin especially in the interests of the students.

DR. THOMAS EGLESTON, emeritus professor of mineralogy and metallurgy in Columbia University, has presented to the University his library and mineralogical collection. The former is especially rich in serials ; the latter contains about 5,000 valuable specimens.

MR. CHARLES WHEELER, of Philadelphia, has given $5,000 to Harvard University in memory of his son, Stuart Wadsworth Wheeler, '98, who served in the Porto Rican campaign, and died in Boston a short time ago. The money will be invested, and the interest used as a loan fund in the Lawrence Scientific School.

PRESIDENT WARFIELD has announced a gift of $10,000 to Lafayette College. It is also reported that a gift of $50,000 has been made for the Chemical Laboratory.

IT is proposed to establish, as a memorial to Sir Robert Peel, a scholarship in the Technical School at Blackburn. Mr. Yerburgh has opened the fund with a donation of £1,000.

DR. JAMES LITTLE has been nominated regius professor of medicine in the University of Dublin in the place of Sir John Banks.

PROFESSOR RÖNTGEN, of Würzburg, has declined the call to Leipzig as the successor of Professor Wiedermann.

DISCUSSION AND CORRESPONDENCE.

THE ORIGIN OF MAMMALS.*

THE question under discussion is not new, but one of a series of similar nature and difficulty. The origin of birds, of reptiles, of amphibians and of fishes really precede it, and offer less difficulties in solution. The answer to each, in my opinion, belongs to the future, and how far it may profitably be sought in the present limited state of our knowledge is a fair question in itself.

Too often in the past a discussion on the origin of mammals has seemed a little like the long philosophico-theological controversies in the Middle Ages about the exact position of the soul in the human body. No conclusion was reached, because, for one reason, there were no facts in the case that could settle the question, while the methods of investigation were not adapted to insure a satisfactory answer. The present discussion is on a much higher plane, and the previous speakers have made an admirable presentation of their side of the case. I cannot, however, quite agree with them as to the value of the facts and theories they have presented, and shall consider the question from another point of view.

The mammals, as we know them to-day, are classed by themselves, yet contain such diverse groups that it may fairly be regarded an open question whether all have a common origin. The attempt to ascertain whence they came is likely to bring out indications that they may have had several sources of origin, and this, if so, may help to explain the great diversity among them.

It is, of course, evident that some of the most characteristic features of recent mammals, for example, the hairy covering, the circulatory system and the milk glands, cannot be used in a comparison with fossil forms. The osseous structure only is now available in the early mammals and other vertebrates, and in this alone points of resemblance must be found if different groups are connected genetically.

In considering the relations of reptiles to mammals so far as the fossil forms are concerned, which seems to be the main question before us to-day, I have only time to speak of the skull, and shall refer to some of its salient features already mentioned in this discussion, namely, the teeth, the squamosal bone, the quadrate, the occipital condyles, and with them the lower jaw. These, perhaps, may serve as crucial points in distinguishing the skull of a reptile from that of a mammal, even if they fail to indicate a near affinity between them.

* Remarks in the general discussion on the Origin of Mammals, at the International Congress of Zoology, Cambridge, England, August 25, 1898.

The different kinds of teeth seen in the reptiles regarded as mammalian in type I consider of comparatively small importance, for the reason that the same general forms of teeth are to be found, not merely in the reptiles supposed to be nearest to mammals, but also in other groups widely different. In the crocodiles, for example, the extinct genus *Notosuchus*, recently discovered in Patagonia, has all three kinds of teeth well distinguished. Again, some of the Dinosaurs, especially the genus *Triceratops*, have teeth with two rows, a supposed mammalian character. In some fishes, also (*Anarrhichas*), three kinds of teeth may be seen. It is more than probable, therefore, that the peculiar resemblance between the teeth of mammals and those of the lower vertebrates is merely one of parallel development, the adaptation being along similar lines, and in no sense an indication of genetic affinity.

The great development of the squamosal bone in Theriodonts is not seen in them alone, for somewhat similar proportions are found in other reptiles, for example, in the Plesiosaurs, where the squamosal is very large, and wrapped around the quadrate. In some of the Dinosaurs, also (*Torosaurus*), the squamosal has an enormous development, while the quadrate remains of very moderate size.

The quadrate bone, always present in birds, reptiles and other lower vertebrates, is well known as the suspensorium of the lower jaw, which meets it with a concave articular face. The quadrate, however, appears to be wanting in mammals, or at least has not yet been identified with certainty.

What represents the quadrate bone in mammals is a vexed question in itself, and some of the best anatomists in the past, Cuvier, Owen, Peters, Huxley and others, have endeavored to solve the problem. The tympanic bone, the incus and the malleus have each in turn been regarded as the remnant of the quadrate, but up to the present time the question has not been settled. It is not improbable that the quadrate may have coalesced with the squamosal.

The occipital condyles of mammals, as well known, are two in number, and separated from each other. This is not the case with any true reptile, although the contrary has been asserted. The nearest approach appears to be where there is a single bifid condyle, cordate in shape, with the two lobes meeting below, as in some reptiles and a few birds, but not separate as in mammals and amphibians.

Finally, in all known mammals, recent and extinct, the lower jaw is composed of a single piece, and has a convex condyle meeting the skull by a distinct articulation. All reptiles, even those supposed to be nearest the mammals, have the lower jaw composed of several pieces, and these show distinct sutures between them, a profound difference that must be explained away before an approach can be made between the two classes.

It may fairly be said that the separate elements of the lower jaw, if present, would naturally be looked for in the Mesozoic mammals, and this point I have long had in mind. I may safely say that I have seen nearly every species of Mesozoic mammals hitherto described, and have searched for evidence on this point without success. I have also sought for the separate elements in the young of recent forms, but without finding any indications of them.

Beside the crucial points I have mentioned in the skull, there are others of equal importance in the skeleton, which I must not take time to discuss, but will venture to allude to one of them in passing. I refer to the ankle joint, which, when present, is at the end of the tibia in mammals, but in reptiles between the first and second series of tarsals. When we really find an approach between these two classes the ankle joint will probably show evidence of it.

Having thus shown, as I believe, that we cannot, with our present knowledge, expect to find the origin of mammals among the known extinct reptiles, and that in attempting this we are probably off the true line of descent, it remains to indicate another direction in which the quest seems more promising.

Since 1876, when Huxley visited me at New Haven, and we discussed the probable origin of both birds and mammals, I have been greatly impressed by his suggestion that the mammals were derived from ancestors with two occipital condyles, and these were doubtless primitive

amphibians. I have since sought diligently for the ancestors of birds among the early reptiles, with, I trust, some measure of success, but this is a simple problem compared with the origin of mammals which we have before us to day.

In various interviews with Francis Balfour, in 1881, at the York meeting of the British Association, we discussed the same questions, and agreed that the solution could best be reached by the aid of embryology and paleontology combined. He offered to take up the young stages of recent forms, and I agreed to study the fossils for other evidence. His untimely death, which occurred soon after, prevented this promised investigation, and natural science still suffers from his loss. Had Balfour lived he might have given us to-day the solution of the great question before us, and the present discussion would have been unnecessary.

The birds, like the mammals, have developed certain characters higher than those of reptiles, and thus the two classes seem to approach each other. I doubt, however, if they are connected genetically, unless in a very remote way.

Reptiles, although much lower in rank than birds, resemble mammals in various ways, but this may be only an adaptive likeness. Both of these classes may be made up of complex groups only distantly related. Having both developed along similar lines, they exhibit various points of resemblance that may easily be mistaken for indications of real affinity.

In the amphibians, especially in the oldest forms, there are hints of a true relationship with both reptiles and mammals. It seems to me, therefore, that in some of the minute primitive forms, as old as the Devonian, if not still more ancient, we may yet find the key to the great mystery of the origin of mammals.

O. C. MARSH.

ZOOLOGICAL BIBLIOGRAPHY.

TO THE EDITOR OF SCIENCE: I am glad to see from Mr. Bather's letter in SCIENCE (No. 207) that the recommendations of the Committee on zoological and botanical publications are not what one would be justified in inferring from the printed abstract on which my remarks were founded. All zoologists are under obligations to Mr. Bather and his associates for their labors in the more arid, but not the less essential, branches of the subject. We hope to be still more grateful to them when their present task is completed, and, therefore, avail ourselves freely of the invitation to criticise the incomplete work in order that the completed structure may become more universally acceptable.

Nevertheless, I find even in his new presentation of the subject a lingering trace of the assumption that certain things are settled which do not appear to me to be determinate. What is the definition adopted by the committee of the phrases 'distributed privately' and 'published in the regular manner'? Upon this depends whether all that follows may be acceptable or not. How many is 'a few?' What is 'public' and what is 'private?' This sort of thing should not be left doubtful. The answers are by no means a matter of course.

When an author, to avoid two or three years' delay, pays for the prompt publication of his researches he does not, in my experience, lock up his copies in a safe and take his name out of the Naturalist's Directory. On the contrary, he at once distributes copies to the journals interested in his branch of science and to the experts in his special line, and sends a copy to Friedländer for the *Natura Novitates*, where it is advertised at a price. If he should omit the latter (a most improbable suggestion), and the paper is of interest, he will certainly be called on and glad to furnish copies to those desiring them. The author who does not desire publicity for his work, and has no known address, in my opinion is a myth. Why otherwise should he print at all?

I quite agree that the paper must be made available to those who wish to purchase it, but I do not for a moment admit that this must be solely through the Society in whose Proceedings it sees the light.

How about the highly genteel persons who publish in *éditions de luxe* of 100 copies? Such works are frequently far more inaccessible than those separata distributed by authors.

It seems to me that the committee would do well to state in the fullest detail their ideas of what constitutes publication and how this shall be registered.

My own opinion is that the sort of thing crit-

icised by Mr. Bather is very rare, if not entirely non-existent. In a tolerably active and rather long experience I have never known of an instance of the sort he mentions. Of course, there may be such, but in the lines I am familiar with I have never come across one.

Of far more practical importance to workers are the concealment by Societies of the true date of issue of their publications and the false dates of some well-known periodicals. Glaring instances of this unscientific procedure will occur to everybody. This is an evil which the committee would be generally supported in denouncing. Every issue of a periodical, or, better, every signature, should have the actual date of printing upon it. When this is delayed until a whole volume is printed the possessor of an extract is left in the lurch. The dating would cost nothing to the Societies and would often save the isolated worker hours of weary labor.

WM. H. DALL.

SMITHSONIAN INSTITUTION, December 21, 1898.

LEHMAN AND HANSEN 'ON THE TELEPATHIC PROBLEM.'

TO THE EDITOR OF SCIENCE: Professor Titchener in to-day's SCIENCE assumes that Messrs. Lehman and Hansen have performed a work of definitive demolition in the well-meant article of theirs to which he refers. If he will take the pains to read Professor Sidgwick's criticism of their results in the S. P. R. *Proceedings*, Vol. XII., p. 298, as well as the note to my report of his paper in the *Psychological Review*, Vol. IV., p. 654, he will probably admit that, owing to the fewness of the data which they collected, they entirely failed to prove their point. This leaves the phenomena in dispute still hanging, and awaiting a positive interpretation from other hands.

I think that an exploded document ought not to be left with the last word, even for the sake of 'scientific psychology.' And I must incidentally thank Professor Titchener for his admission that 'aloofness, however authoritative' (which phrase seems to be *style noble* for 'ignorance of the subject, and be d — d to it'), is an attitude which need not be invariably maintained by the 'Scientific,' even towards matters such as this. I only wish that his admission were a little less apologetic in form.

CAMBRIDGE, MASS., WILLIAM JAMES.
December 23, 1898.

SCIENTIFIC LITERATURE.

Footnotes to Evolution. A series of popular addresses on the evolution of life. By DAVID STARR JORDAN, PH.D., President of Leland Stanford Junior University. With supplementary essays by EDWIN GRANT CONKLIN, PH.D.; FRANK MACE MCFARLAND, PH.D.; JAMES PERRIN SMITH. New York, D. Appleton & Co. 1898. Price, $1.50.

Although the title of this book does not seem entirely self-explanatory or expressive, the lay reader will gain from a perusal of the volume a clear idea of what evolution means. He will also realize that what has been worked out in the world of animal life applies equally well in the main to man himself. Though man is an animal he is much more, and problems of existence arise in the social, moral and spiritual realms which are quite foreign to the subjects investigated by the zoologist only.

Dr. Jordan himself discusses, in a homely but clear and attractive and at times pithy and telling way, the 'kinship of life,' 'evolution: what it is and what it is not;' 'the elements of organic evolution;' 'the heredity of Richard Roe;' 'the distribution of species,' latitude and vertebræ;' finally attacking such subjects as 'the evolution of the mind,' 'degeneration,' 'hereditary inefficiency,' 'the woman of evolution and the woman of pessimism,' 'the stability of truth' and 'the struggle for realities.'

While the facts of organic evolution, or, to use Geddes' term, bionomics, are discussed in an interesting way, we have given us few new facts or views, but current facts, opinions and inferences are presented in a readable form. We should naturally have expected, in the chapter on the distribution of species, to be treated to the discussion of data drawn from a study of the animals of California, for the relation of the local varieties or incipient species to their environment is very striking on the Pacific coast, and could be made very interesting and suggestive to readers not possessing a special knowledge of the matter. To be sure,

the heads of some chipmunks of California, showing distinct species produced through isolation and very well drawn by Mr. W. S. Atkinson, forms the frontispiece, though we have been unable to find any reference to it in the text.

Dr. Jordan's own studies on the relation between latitude and the number of vertebræ contains many interesting facts, but these are not correlated with a number of similar cases of change in structure characterizing local varieties and races, which would throw more light on this attractive subject, though all these cases appear primarily to be due to local or comparatively restricted changes of the environment, and secondarily to isolation.

The chapter on 'the evolution of fossil cephalopoda,' by Dr. Smith, gives the results, some very striking, of long-continued studies on the evolution of these animals, and will be of much value to the specialist in paleontology. It is illustrated by five excellent plates.

The reviewer hardly feels qualified to pass judgment on the sociological chapters, but has enjoyed reading them and thinks that they merit attention, and will undoubtedly secure it from a wide circle of readers. They are all concerned with some of the burning questions of the day. The fancy sketch of 'the heredity of Richard Roe' is very well done. Based on the essays of Galton and others, with studies of his own, our author shows that the same conditions which have resulted in the formation of the English race will apply to such a colonial type as ours, and that in a few centuries "these same conditions will unite to form a 'Brother Jonathan' as definite in qualities and as 'set in his ways' as his ancestor, the traditional 'John Bull.'"

The chapters on 'the evolution of the mind,' 'degeneration,' 'hereditary inefficiency,' 'the woman of evolution and pessimism,' 'the stability of truth' and 'the struggle for realities' contain strong, wholesome thoughts presented in a clear, simple, homely style, which seem to us sound, progressive and most timely. When our race, and our people especially, wake up to and realize the strength and nature of the forces for evil, the tendencies to degeneration, and begin to battle with and overcome these—when that moment arrives, our nation need not fear the negro problem, the pauper phantoms of the submerged thousands of our cities or the scandalous influence of our boss politicians. Then with the ever-growing strength resulting from long striving and experience in ruling the savage and barbarian elements actually among us, we can reach out and absorb, and perhaps turn to some good use, rather than exterminate, the millions of the barbarous and uncivilized of the Philippines, which have suddenly drifted in upon us as the wreckage of war.

A. S. PACKARD.

Earth Sculpture or the Origin of Land-forms. By JAMES GEIKIE. New York, G. P. Putnam's Sons. 1898. Illustrated.

The editors of The Science Series are fortunate in their selection of the author of this volume. Dr. James Geikie, Murchison professor of geology in the University of Edinburg and author of 'The Great Ice Age,' is one of the ablest and best known geologists in Europe. His wide acquaintance with geological phenomena, his experience as a teacher and his conservatism make him an eminently fit and safe person to follow into a field that has been explored of late years by so many enthusiasts.

We feel thankful, too, that the subject has been treated by a man who concerns himself with the processes and results of earth sculpture, and but little with the names that have of late years been so copiously showered upon them. Dr. Geikie tells us in the preface that he has 'made scant use of those neologisms in which, unfortunately, the recent literature of the subject too much abounds.' A glossary is given at the end of the work for such technical terms as are indispensable.

The volume does not pretend to be a textbook on physiography. Its scope is best indicated by the contents, which are briefly as follows:

Agents of denudation.

Land forms { in horizontal strata,
in gently inclined strata,
in highly inclined strata,
in faulted regions,
due to igneous action.

Rock character and land forms.

Land forms modified by { glacial action,
æolian action,
underground water.

Basins.
Coast lines.
Classification of land forms.

These subjects are necessarily treated briefly owing to the limitations imposed by the size of the book, but they are all treated ably, and as the reader leaves each topic behind he feels that the author has not pumped his reservoir of knowledge dry.

If one wishes to find fault with a topographic map he need only go into greater detail or use a larger scale than was used by the maker of the map; if one would find fault with a book of this kind he needs only go a little further into the details of the processes and results under discussion. On this principle one may venture the following criticisms:

On page 46 the author says that the three main factors determining land forms are: (1) original slope; (2) geological structure; (3) character of the rocks. If he had cared to go into greater detail and finer subdivision of these factors he might have added to this list: (4) climatic conditions; (5) interruptions during development; (6) duration of exposure; (7) nature of denuding agency; (8) slope during development. Such subdivisions, however, are mere matters of convenience in discussion; the subjects themselves have not been overlooked.

It would have been well for American readers if the author had noted that the 'swallow-holes,' *dolinas*, 'kettle-valleys,' etc., spoken of on page 271 are known in this country as 'sink-holes.'

On pages 267–8 the author expresses the opinion that earthquakes may sometimes be caused by the falling-in of the roofs of caverns. To a person living in an earthquake region this seems to be an inadequate, or rather a highly exceptional, cause of earthquakes. Limestone regions are not generally looked upon as earthquake regions.

On page 284 æolian basins are mentioned 'as occurring in Arkansas.' These basins are not in Arkansas, but in the valley of the Arkansas River. In common with many other writers, he gets the name of *Rio de Janeiro* wrong (330, 332). To call it 'Rio Janeiro' is equivalent to calling a man Kinley when his name is McKinley. The editor may be warranted from analogy in spelling *pulverise* so (pp. 30, 32), but neither Webster nor the Century gives such a spelling.

The illustrations are, on the whole, not up to the standard of the text. Most of them are smudged as if reproduced on the scale on which they were hastily drawn.

But these are all very small matters, and have little to do with the general merit of the book. It ought to be remembered, too, that Dr. Geikie is no mere maker of books. He is a busy scientific worker, who can find time only with great difficulty for writing a work of this character, and whatever one finds to criticise in this book is not to be attributed to any unfitness or unfamiliarity on his part with the subject he is dealing with.

Several references in the work to the relations of geology and earth-sculpture afford an occasion for referring to a doctrine being promulgated in this country of late years by enthusiasts on the subject of physiography, physical geography, earth-sculpture or whatever one may choose to name it, in the grammar and high schools, and even in the primary grades themselves.

Dr. Geikie says, on page 45: "So dominant, indeed, has been the influence of geological structure in determining the results worked out by erosion that without a knowledge of the structure of a country we can form no reliable opinion as to the origin of its surface features." At the end of the book he returns to this subject. On page 364 he concludes "that these (surface features) cannot be accounted for without some knowledge of geological structure." On page 367 he says: "It is almost impossible, indeed, to consider the formation of surface features without at the same time inquiring into their geological history. And not infrequently we find that the configuration of a land is the outcome of a highly involved series of changes. To understand the distribution of its hills and valleys, its plains and plateaux, and the whole adjustment of its hydrographic system, we may have to work our way back to a most remote geological period."

The book is made up of facts, almost every one of which is a silent witness to the correctness of this conclusion. Physiography is a study for mature minds, and it cannot successfully be

taught as a science to those who have no knowledge of geology. However much entertainment a boy or girl may get from dabbling in these subjects, for the common run of students they are university studies or studies for minds capable of doing university work.

JOHN C. BRANNER.

STANFORD UNIVERSITY, CALIFORNIA,
December 1, 1898.

The Story of Photography. By ALFRED T. STORY. The Library of Useful Stories. New York, D. Appleton & Co. 1898.

In this little book of one hundred and sixty-five pages, which can be carried in the pocket, the author has gathered together an epitome of the gradual development of photography from the early attempts of Schultze in 1727 to the present day. The experiments of Wedgwood and Davy, Niépce, Daguerre, Fox, Talbot and St. Victor are given at length. An account of the usual printing processes, of photo-block printing and reproduction processes for illustrating, are included; also the recent application of the X-ray and the kinetoscope. There is just enough of physics and optics to enable the lay reader to form a good idea of the principles on which photography is based. 'The Story of Photography' reads easily and pleasantly, and it is doubtful if elsewhere in so small a compass can be found as comprehensive a description of an art that has so wide and varied applications. It will undoubtedly form a desirable addition to many private libraries.

E. L.

SCIENTIFIC JOURNALS.

American Chemical Journal, December. 'Camphoric acid:' By W. A. Noyes. In this paper, which is a continuation of former reports, the methods of preparation and the derivatives of xylic acid and xylidene are described. 'On some relations among the hydrates of the metallic nitrates:' By J. H. Kastle. Attention is called to the amount of water of crystallization of the different nitrates and the explanation that can be given for the complex and basic compounds. 'Liquid ammonia as a solvent:' By E. C. Franklin and C. A. Kraus. The solubility of about 400 substances has been determined. 'Determination of the molecular rise in the boiling point of liquid ammonia:' By E. C. Franklin and C. A. Kraus. 'On the non-existence of four methenylphenylparatolyl amidines:' By H. L. Wheeler and T. B. Johnson. 'An active principle in millet hay:' By E. F. Ladd. 'Comparison of methods for estimating caffein:' By E. F. Ladd. 'Creatin and its separation:' By E. F. Ladd and P. B. Bottenfield. 'A double citrate of zirconium and ammonium:' By S. H. Harris.

J. ELLIOTT GILPIN.

THE *Revue des Sciences Médicales*, an excellent quarterly journal, established twenty-six years ago and edited by M. Hayem, has been compelled to suspend publication. *L'Éducation Mathématique* is a new journal edited from Paris by Professors J. Griess and H. Vuibert.

SOCIETIES AND ACADEMIES.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 491st meeting of the Society was held at the Cosmos Club, December 10th, at 8 p. m. Mr. W. H. Dall spoke on the proposed University of the United States, to establish which efforts are being made in pursuance of the ideas of Washington expressed in his will; and its possible relations to the scientific bureaus of the government.

He thought that the projectors of the enterprise should avoid any official connection with the government and that the institution should not attempt to duplicate the undergraduate work of existing colleges with which the city is already abundantly supplied. He then outlined a scheme for post-graduate work in connection with the scientific bureaus which he believed practicable and which would occupy a promising field at present unutilized, and which would also involve a minimum of expense, little legislation and no costly buildings. The paper as a whole will appear in the *American Naturalist*.

The second paper, on 'Two Remarkable Semi-diurnal Periods,' was by Professor F. H. Bigelow, of the United States Weather Bureau. An account was given of the three components of the diurnal barometric wave, their distribution and variations in different latitudes, and of

the theories which have been advanced to account for them, with the difficulties which are encountered by them. The variations in the barometric pressure as given by the observations were redistributed relatively to the magnetic poles, the components taken, and compared with the deflecting magnetic forces which cause the daily variation of the needle. It was shown that both systems have a belt of transition near latitude 60°, and a displacement of phase by six hours in the polar regions. Other similar features were indicated, suggesting some mutual dependence between these systems.

A second comparison of these deflecting forces with the diurnal components of wind velocities in middle latitudes exhibited a remarkable agreement in their directions and their turning points. Some statement was made regarding the causes of this phenomenon.

E. D. PRESTON,
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

THE Society met November 16th, with eighty-five persons present.

Professor W. Z. Ripley spoke of the racial characteristics of the Jews. The Jews and the Gypsies, alone of European races, preserve their individuality without territory. The numbers, distribution and origin of the European Jews were given in detail ; in Europe they are widely and unevenly scattered ; probably one half are to be found in Poland and southwestern Russia. For America, though official data are wanting, there are probably one million. The small size of the Jews is marked and is due to hostile legislation, starvation, oppression and environment. The Jews are essentially a town people, and town life tends to depress stature. The inheritance of their short stature is still questioned. Their chest development is small, but in spite of physical degeneracy statistics show that the Jews live twice as long as Christians. The head variation of European races was noted ; in the Jews the head form is not persistent and does not indicate purity. The facial characteristics, form of nose, color of hair and eyes of the Jews were described, and the geographical distribution of the race in Europe, their average stature in European countries and the types of head form were illustrated by lantern views.

SAMUEL HENSHAW,
Secretary.

NEW YORK ACADEMY OF SCIENCES—SECTION OF ASTRONOMY AND PHYSICS.

AT the regular monthly meeting of the Section of Astronomy and Physics, held December 5, 1898, Mr. Wallace Goold Levison presented a paper on 'A Classification of the Phosphorescent and Fluorescent Substances,' in which he grouped under the former head all those that give out shorter radiations than they receive, while under the latter he placed those that give out longer radiations than they receive. Each heading was then amplified by sub-headings referring to the manner or circumstances in which a substance phosphoresces or fluoresces.

For instance :

Phosphorescent	Thermo-	Heated or cooled.
	Electro-	Statically electrified.
		Exposed to X-rays.
	Lumino-	
	Tribo-	Rubbed.
		Compressed.
		Hammered.
	etc.	

In the same way the fluorescent substances were subdivided.

Mr. Levison showed his system by means of lantern slides of tables or charts on which the substances were arranged as above. He exhibited a large number of slides, and received the congratulations of the members present for the painstaking labor that he had spent upon the subject, as well as for the logical arrangement of the same.

R. GORDON,
Secretary of Section.

NEW BOOKS.

Studien über Säugethiere. MAX WEBER. Jena, Gustav Fischer. 1898. 2d Part. Pp. v+152. 12 Marks.

Physical Geography. WILLIAM MORRIS DAVIS, assisted by WILLIAM HENRY SNYDER. Boston and London, Ginn & Co. 1898. Pp. xvii+428.

Degeneracy: Its Causes, Signs and Results. EUGENE S. TALBOT. New York, Charles Scribner's Sons ; London, Walter Scott, Ltd. 1898. Pp. xvi+372. $1.50.

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